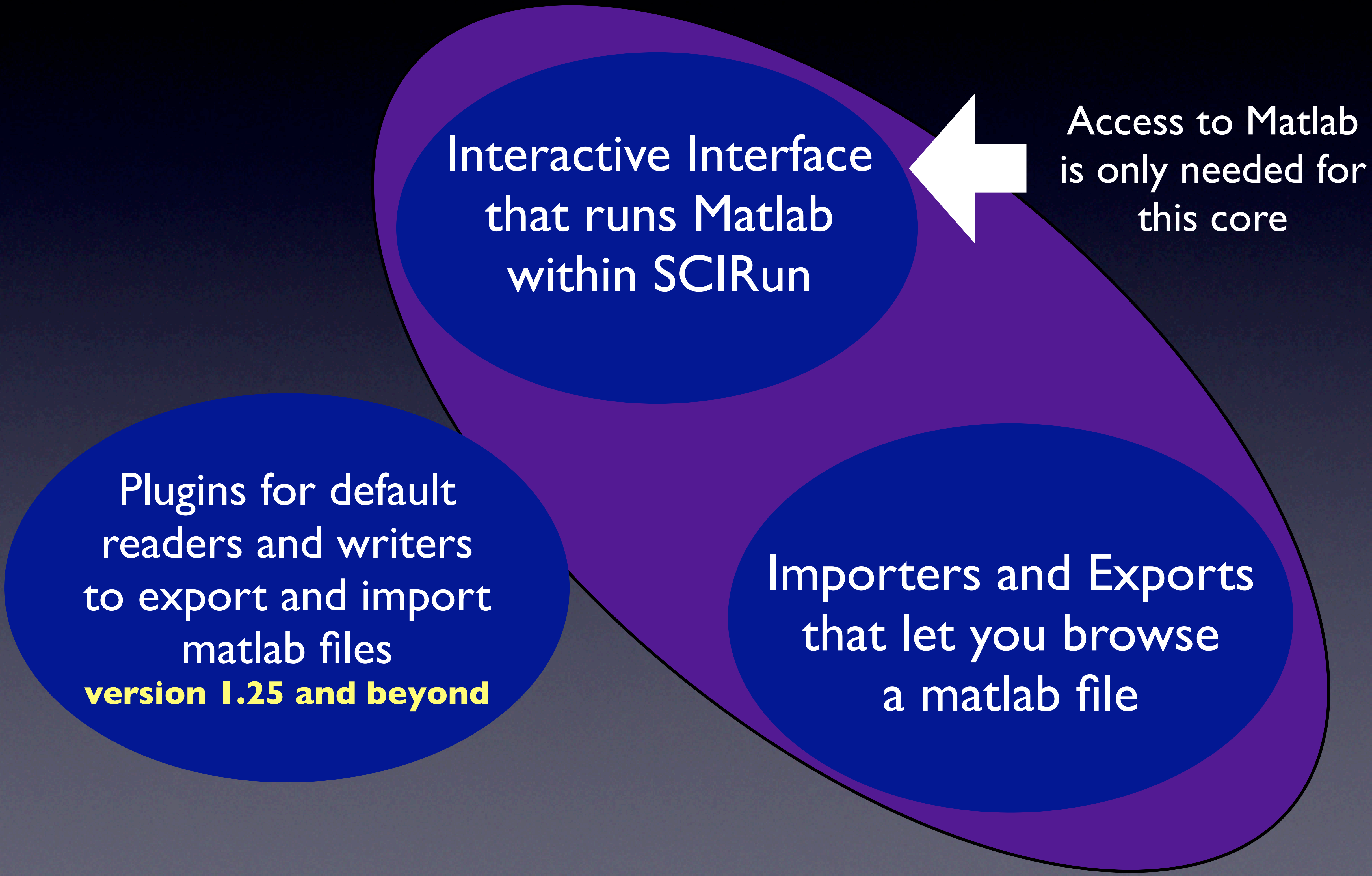
Matlab Interface

- MatlabInterface package is an extension to SCIRun.
- To install the interface:

  ```
  --enable-package=”MatlabInterface”
  ```

- The MatlabInterface package has no external dependencies and Matlab is not strictly needed to run the interface.

Package layout



Interactive Interface that runs Matlab within SCIRun

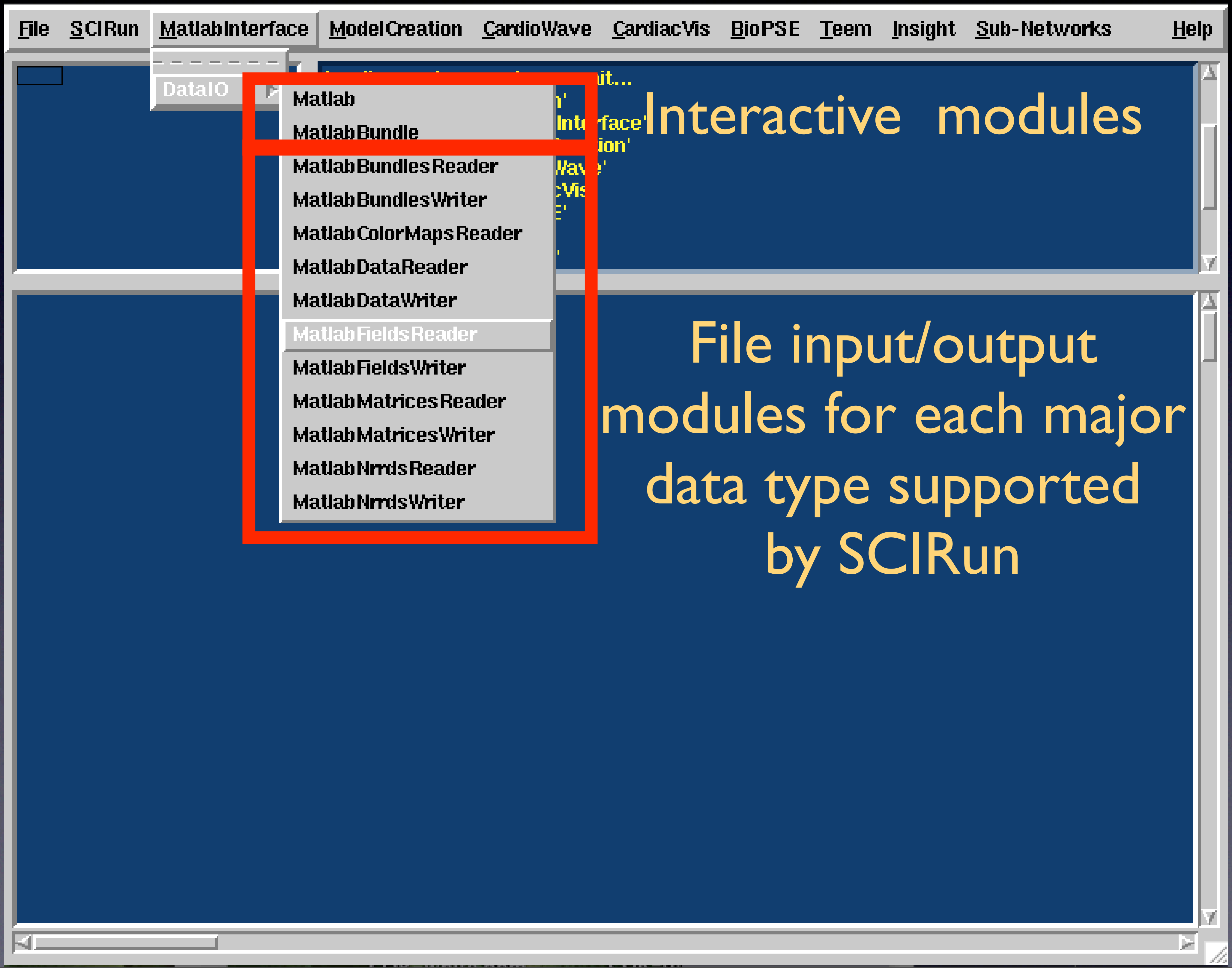
Access to Matlab is only needed for this core

Plugins for default readers and writers to export and import matlab files

version 1.25 and beyond

Importers and Exports that let you browse a matlab file

What is in the package?



Interactive modules

File input/output modules for each major data type supported by SCIRun

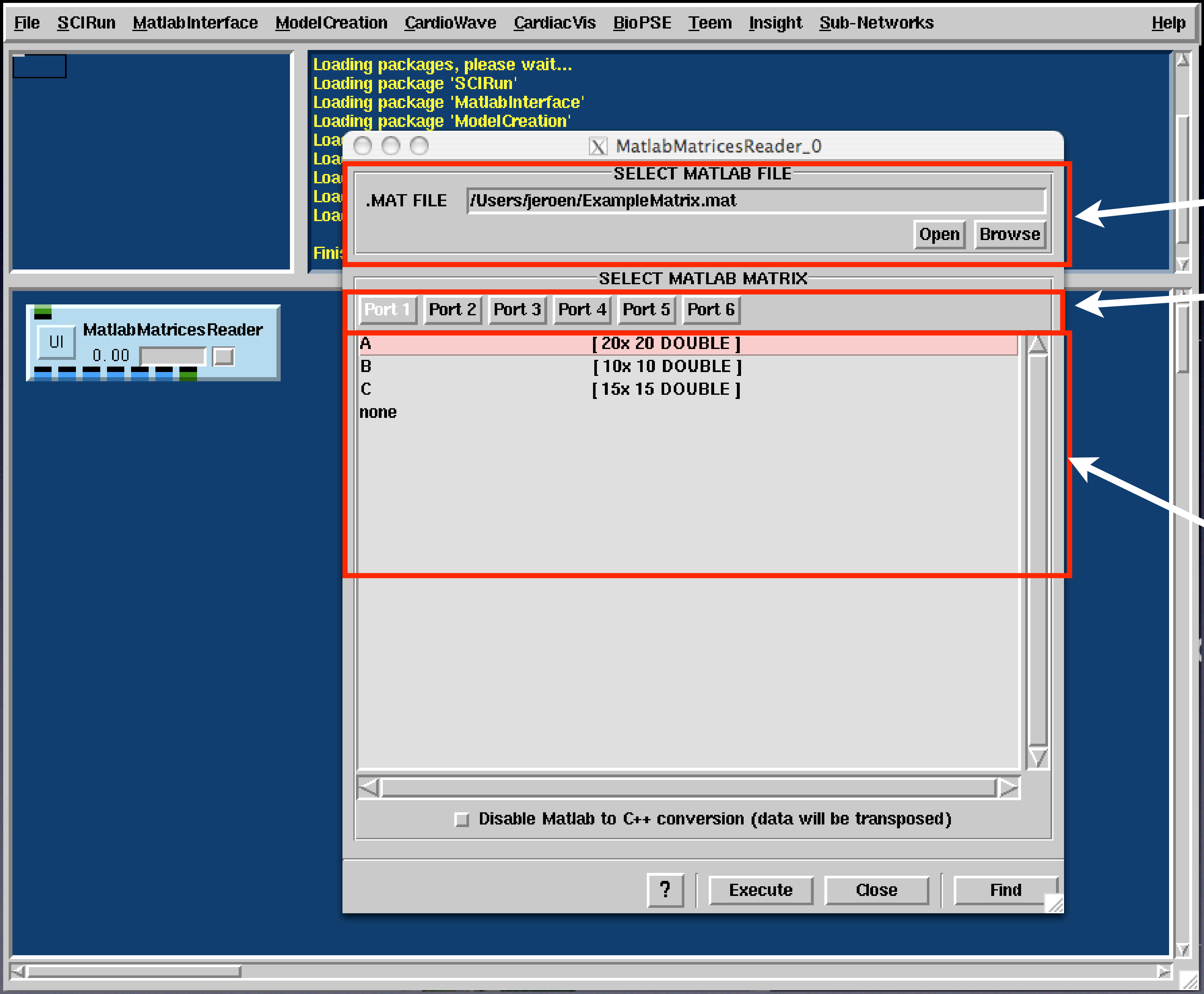
Example 1: Importing a matrix

A sparse or dense matrix in Matlab corresponds to a sparse or dense matrix in SCIRun.

Create an example file in Matlab:

```
>> A = rand(20);
>> B = rand(10);
>> C = rand(15);
>> save ExampleMatrix A B C
```

Example 1: Importing a matrix



File SCIRun MatlabInterface ModelCreation CardioWave CardiacVis BioPSE Teem Insight Sub-Networks Help

```
Loading packages, please wait...
Loading package 'SCIRun'
Loading package 'MatlabInterface'
Loading package 'ModelCreation'
```

.MAT FILE /Users/jeroen/ExampleMatrix.mat

A	[20x 20 DOUBLE]
B	[10x 10 DOUBLE]
C	[15x 15 DOUBLE]
none	

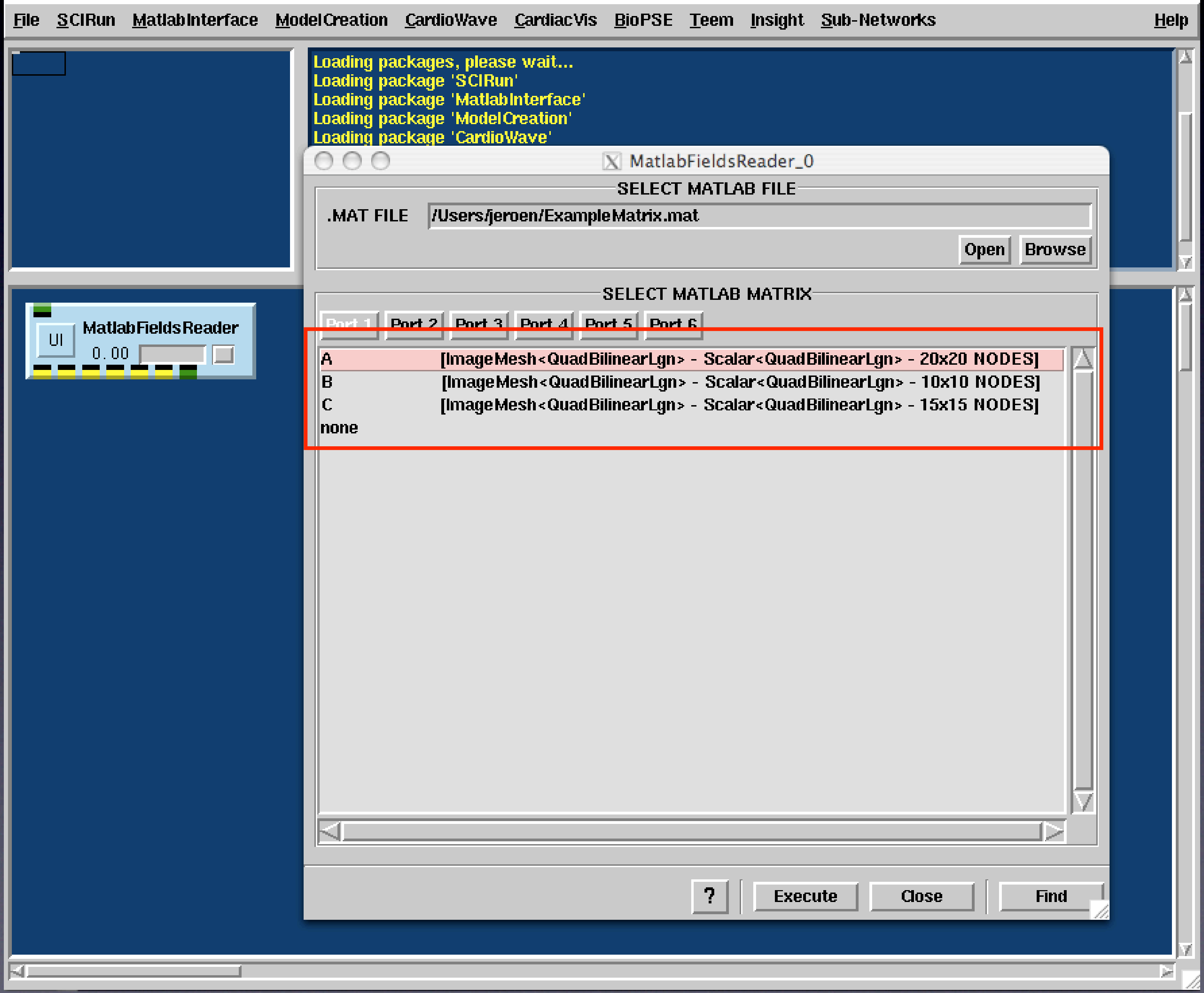
□ Disable Matlab to C++ conversion (data will be transposed)

Select Matlab file

Select Module output port

Select which matrix needs to be projected on the selected output port

Example 2: SCIRun Fields



```
Loading packages, please wait...
Loading package 'SCIRun'
Loading package 'MatlabInterface'
Loading package 'ModelCreation'
Loading package 'CardioWave'
```

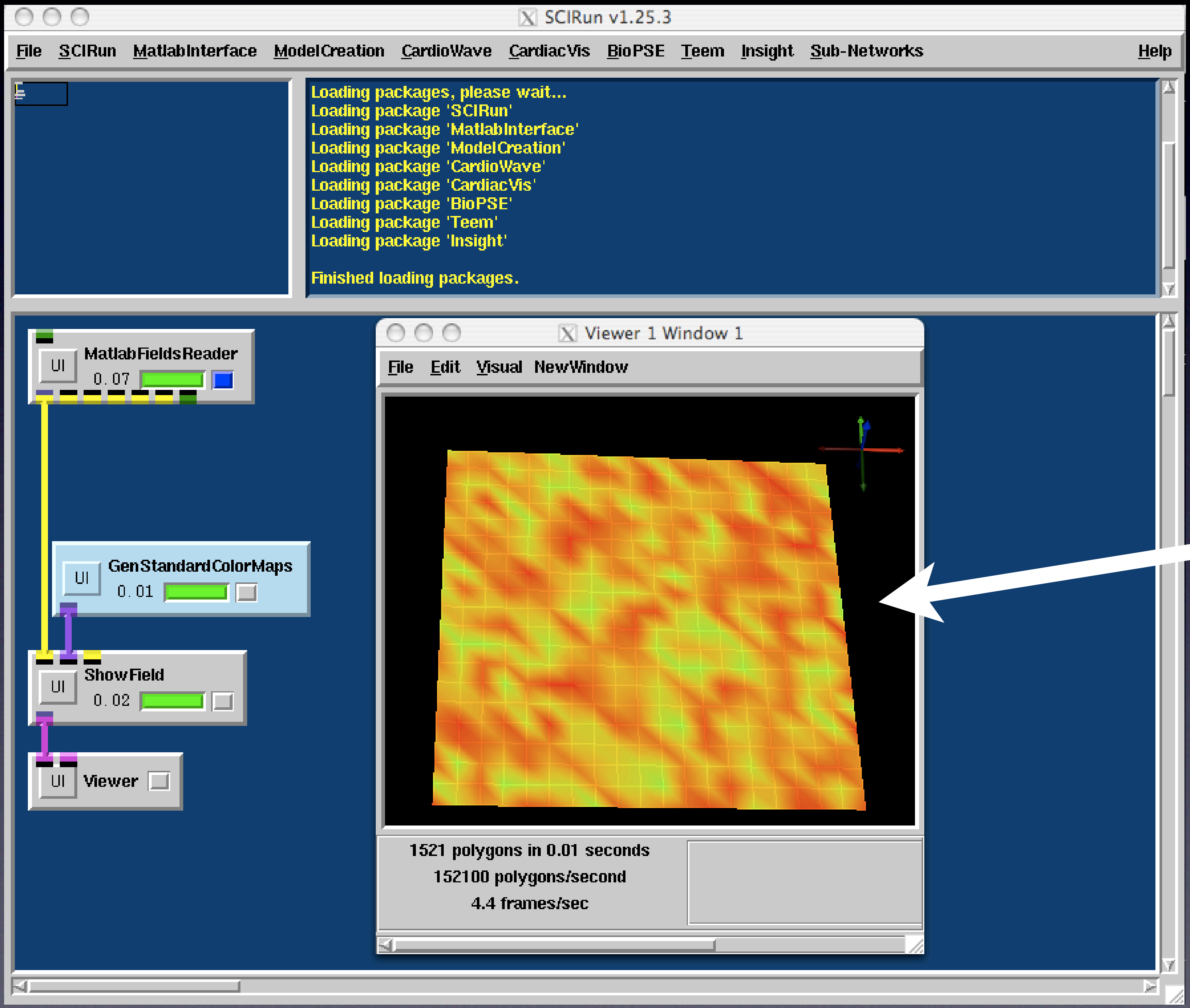
MatlabFieldsReader_0

.MAT FILE /Users/jeroen/ExampleMatrix.mat

```
A          [ImageMesh<QuadBilinearLgn> - Scalar<QuadBilinearLgn> - 20x20 NODES]
B          [ImageMesh<QuadBilinearLgn> - Scalar<QuadBilinearLgn> - 10x10 NODES]
C          [ImageMesh<QuadBilinearLgn> - Scalar<QuadBilinearLgn> - 15x15 NODES]
none
```

Matrix is now interpreted as an ImageMesh and the data in the matrix is interpreted as the data in the field

Example 2: SCIRun Fields



```
Loading packages, please wait...
Loading package 'SCIRun'
Loading package 'MatlabInterface'
Loading package 'ModelCreation'
Loading package 'CardioWave'
Loading package 'CardiacVis'
Loading package 'BioPSE'
Loading package 'Teem'
Loading package 'Insight'

Finished loading packages.
```

```
1521 polygons in 0.01 seconds
152100 polygons/second
4.4 frames/sec
```

Visualization of
the matrix

What about more complex geometries ?

- SCIRun has three major types of mesh classes:
  - Regular mesh with fixed distances between nodes (1D, 2D, or 3D mesh).
  - Structured mesh with variable node positions (1D, 2D, or 3D mesh).
  - Irregular meshes: line, triangular, quadrilateral, textrahedral and hexahedral elements.

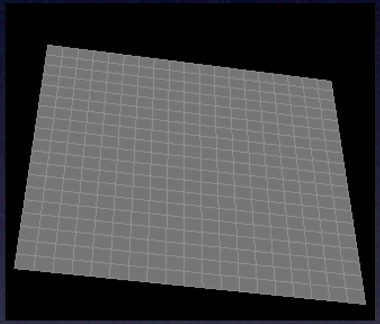
Regular Meshes

Matlab

SCIRun

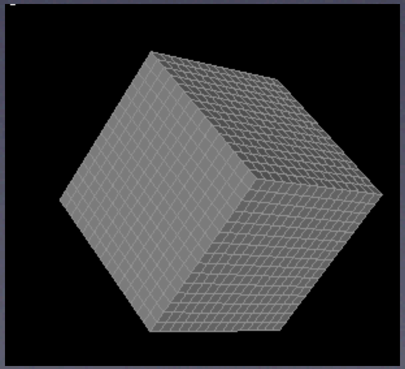
2D Dense matrix

SCIRun Image class



3D Dense matrix

SCIRun LatVol class



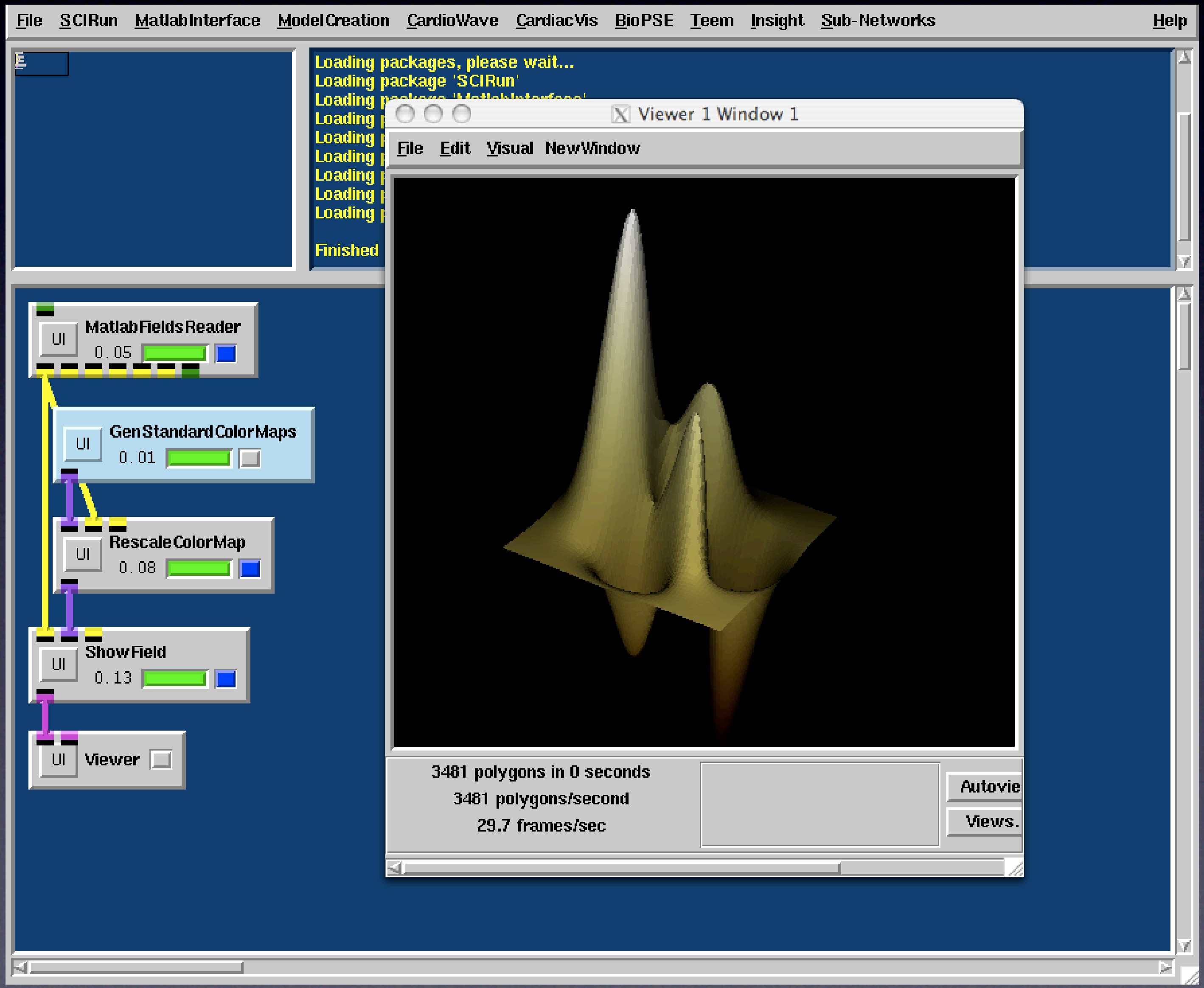
Structured meshes

- We need to provide SCIRun with node coordinates and data values:

```
>> [x,y,z] = peaks(60);

>> sf.x = x;

>> sf.y = y;

>> sf.z = z;

>> sf.field = z;

>> save Example3 sf
```

Matlab Note: The notation <variable>.<fieldname> creates a structured matlab object in which each field can be a matrix or a nested structured array. We use this type of variable to construct most SCIRun objects.

Example of structured mesh



```
Loading packages, please wait...
Loading package 'SCIRun'
Loading package 'MatlabInterface'
Loading p
Loading p
Loading p
Loading p
Loading p
Loading p

Finished
```

```
3481 polygons in 0 seconds
3481 polygons/second
29.7 frames/sec
```

Structured meshes

Field in structured mesh:

.x
.y
.z
.field

Depending on whether the matrix with the x, y, and z positions is a 1D, 2D, or 3D matrix, the object is a 1D, 2D, or 3D Structured SCIRun object.

The field data array should have the same dimensions as the x, y, and z arrays.

If no ‘field’ array is given the object is assumed to be a pure mesh with no data.

If ‘field’ has dimensions that are one smaller than x, y, or z arrays, the data is assumed to be on the cells of the mesh

Unstructured meshes

A point cloud:
.node
.field

A curve:
.node
.edge
.field

A surface:
.node
.face
.field

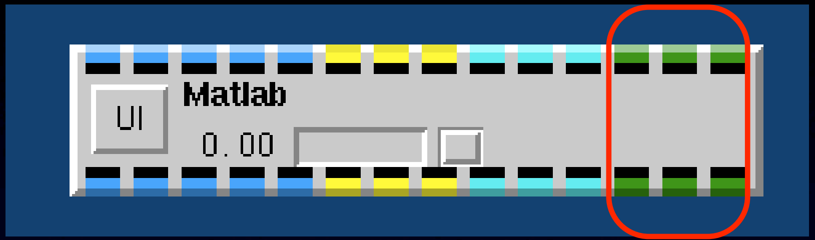
A volume:
.node
.cell
.field

.node is a 3 by N defining all the nodes in the mesh. The points are defined by the x, y, and z coordinates

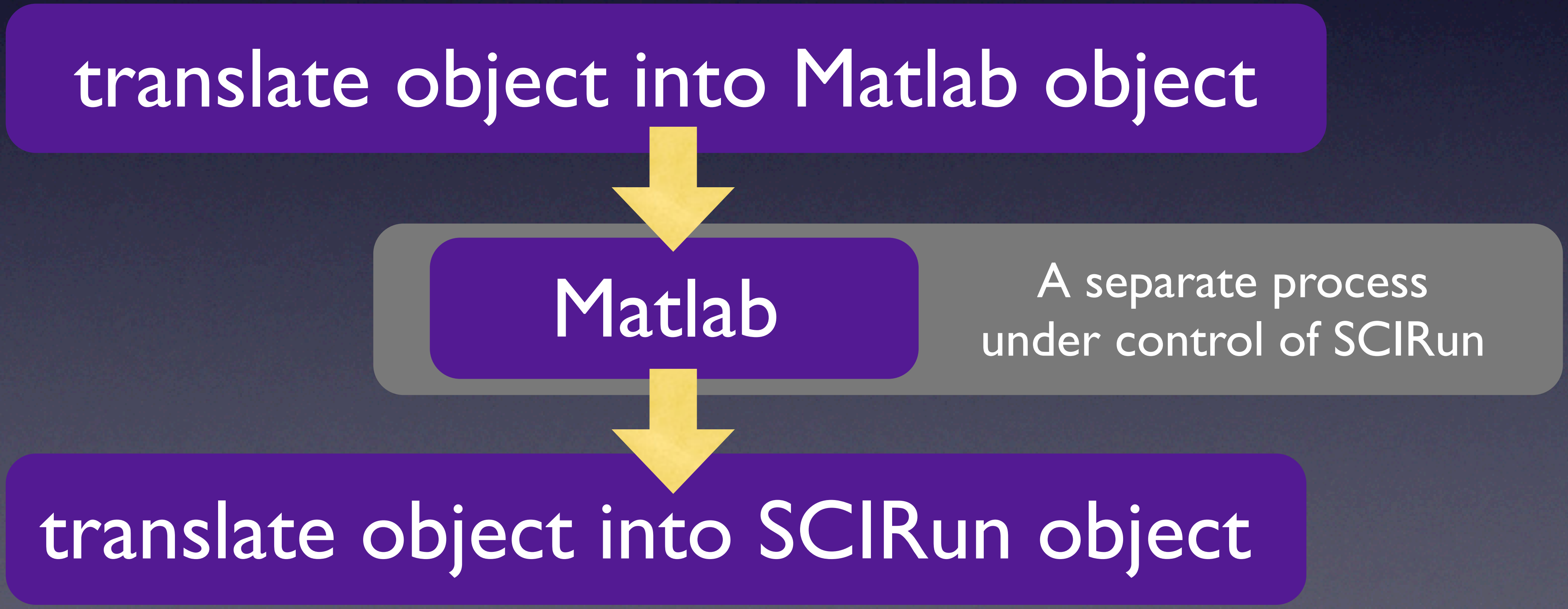
.edge/.face/.cell defining the connectivity of a mesh. For example for a triangular mesh this should be a 3 by M matrix, defining M triangular elements.

.field are the data values at a node or an element. Depending on whether there are N or M values the interface will assign data on the nodes or on the elements. In case N is M it will assign data on the nodes.

Interactive module



extension in version 1.25

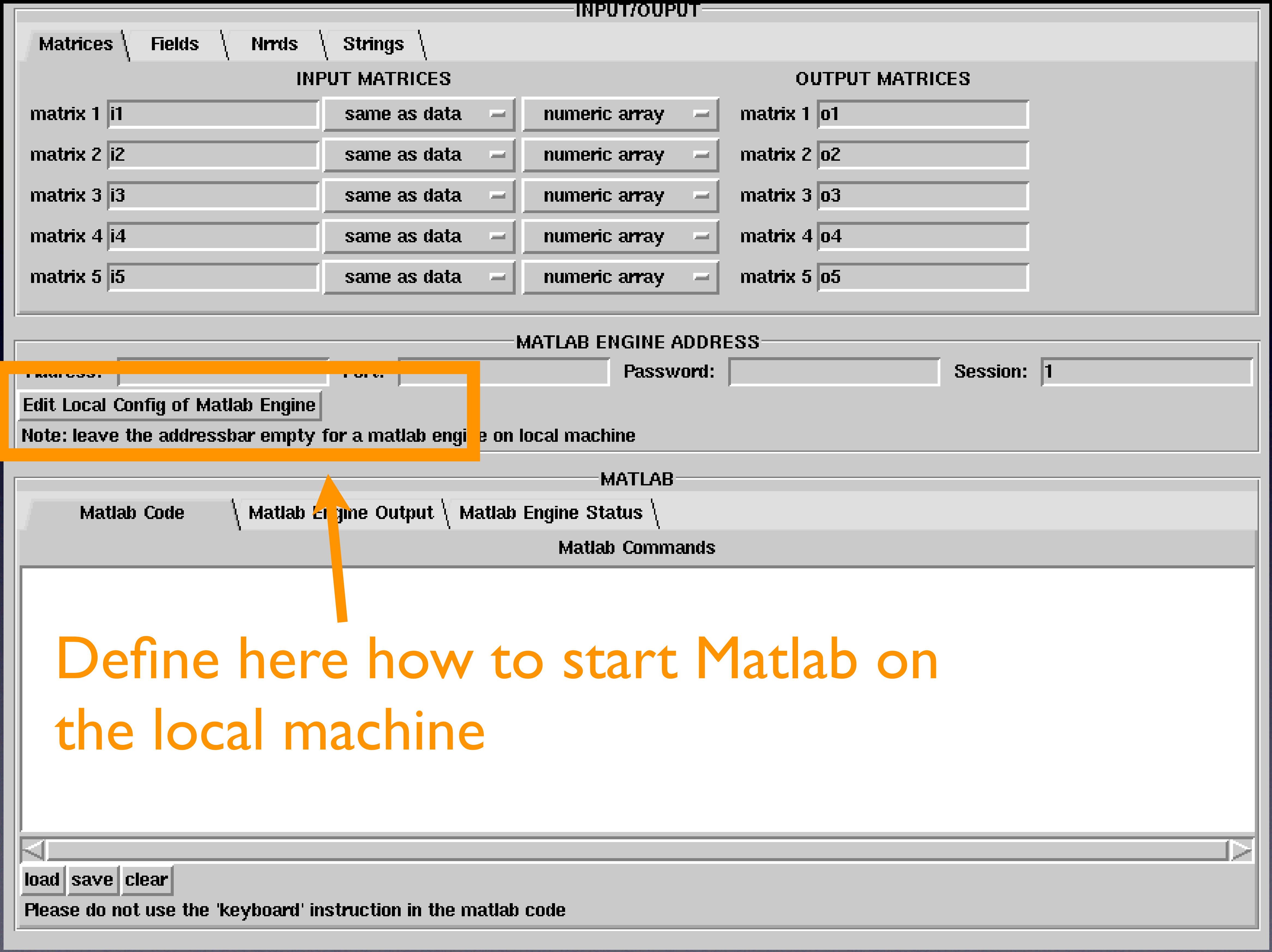


translate object into Matlab object

Matlab

A separate process
under control of SCIRun

translate object into SCIRun object



INPUT/OUPUT

INPUT MATRICES				OUTPUT MATRICES	
matrix 1	i1	same as data	numeric array	matrix 1	o1
matrix 2	i2	same as data	numeric array	matrix 2	o2
matrix 3	i3	same as data	numeric array	matrix 3	o3
matrix 4	i4	same as data	numeric array	matrix 4	o4
matrix 5	i5	same as data	numeric array	matrix 5	o5

MATLAB ENGINE ADDRESS

Address: Port: Password: Session: 1

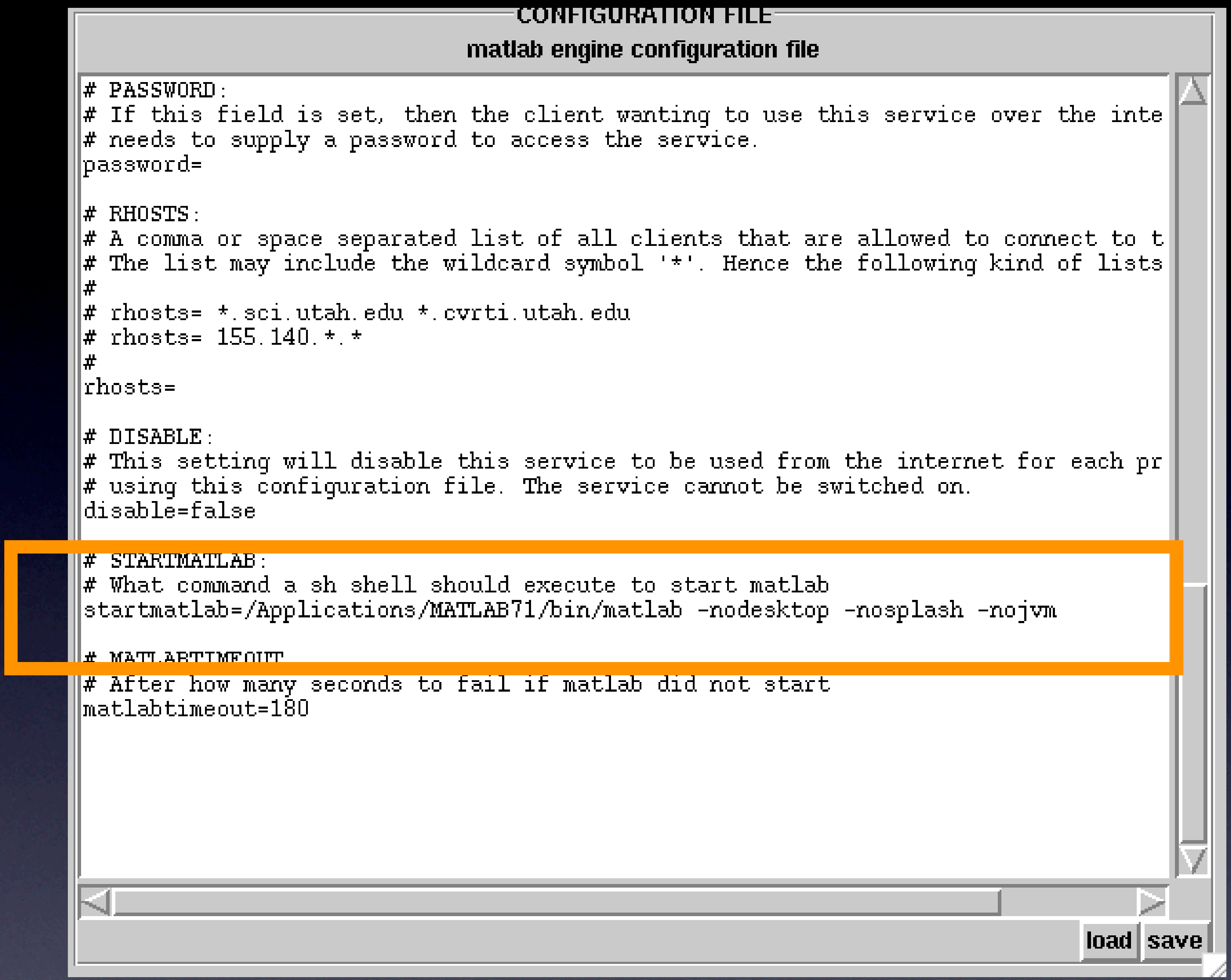
Note: leave the addressbar empty for a matlab engine on local machine

MATLAB

Please do not use the 'keyboard' instruction in the matlab code

Define here how to start Matlab on the local machine

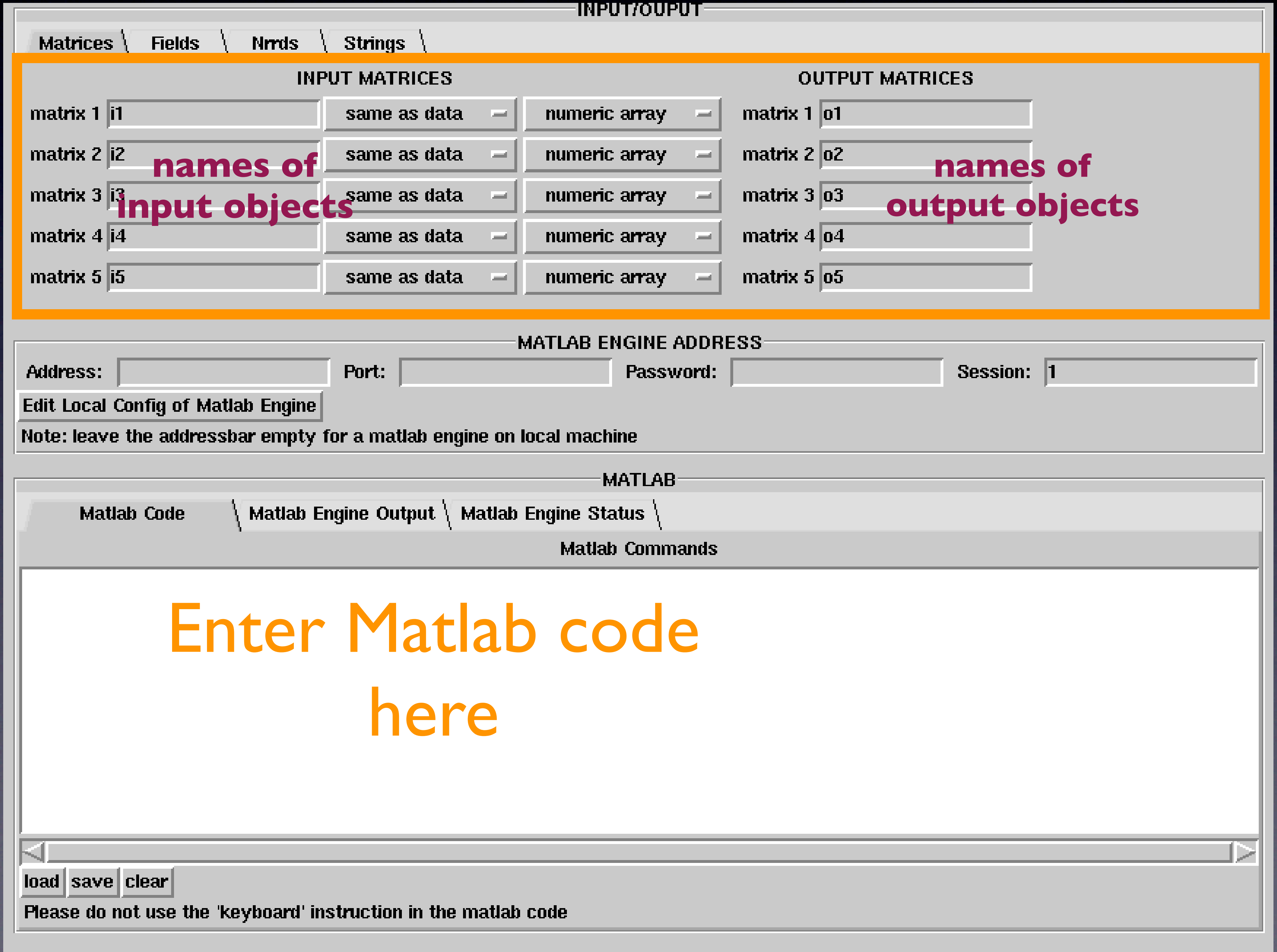
For 1.24: ~/SCIRun/services/matlabengine.rc



```
# PASSWORD:
# If this field is set, then the client wanting to use this service over the inte
# needs to supply a password to access the service.
password=

# RHOSTS:
# A comma or space separated list of all clients that are allowed to connect to t
# The list may include the wildcard symbol '*'. Hence the following kind of lists
#
# rhosts= *.sci.utah.edu *.cvrti.utah.edu
# rhosts= 155.140.*.*
#
rhosts=

# DISABLE:
# This setting will disable this service to be used from the internet for each pr
# using this configuration file. The service cannot be switched on.
disable=false

# STARTMATLAB:
# What command a sh shell should execute to start matlab
startmatlab=/Applications/MATLAB71/bin/matlab -nodesktop -nosplash -nojvm

# MATLABTIMEOUT
# After how many seconds to fail if matlab did not start
matlabtimeout=180
```

To run Matlab within SCIRun:
use '-nodesktop' and '-nojvm' option:
This will disable the graphical user interface so we can interface with Matlab directly

This section describes how the SCIRun data flow objects are loaded into the Matlab Workspace and which objects need to be grabbed at the end of the session



INPUT/OUPUT

INPUT MATRICES

matrix 1	i1	same as data	numeric array
matrix 2	i2	same as data	numeric array
matrix 3	i3	same as data	numeric array
matrix 4	i4	same as data	numeric array
matrix 5	i5	same as data	numeric array

OUTPUT MATRICES

matrix 1	o1
matrix 2	o2
matrix 3	o3
matrix 4	o4
matrix 5	o5

names of input objects

names of output objects

MATLAB ENGINE ADDRESS

Address: Port: Password: Session: 1

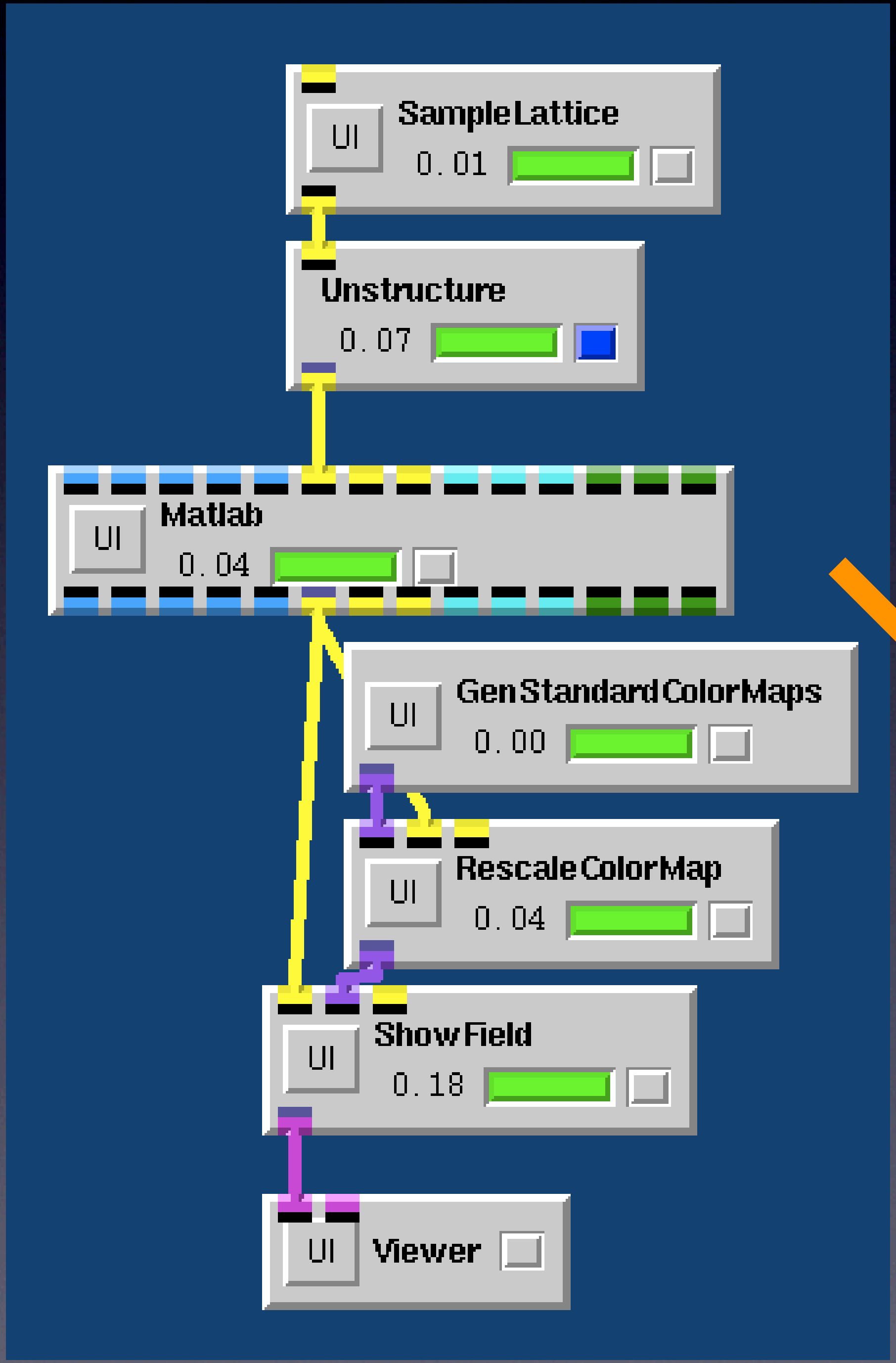
Note: leave the addressbar empty for a matlab engine on local machine

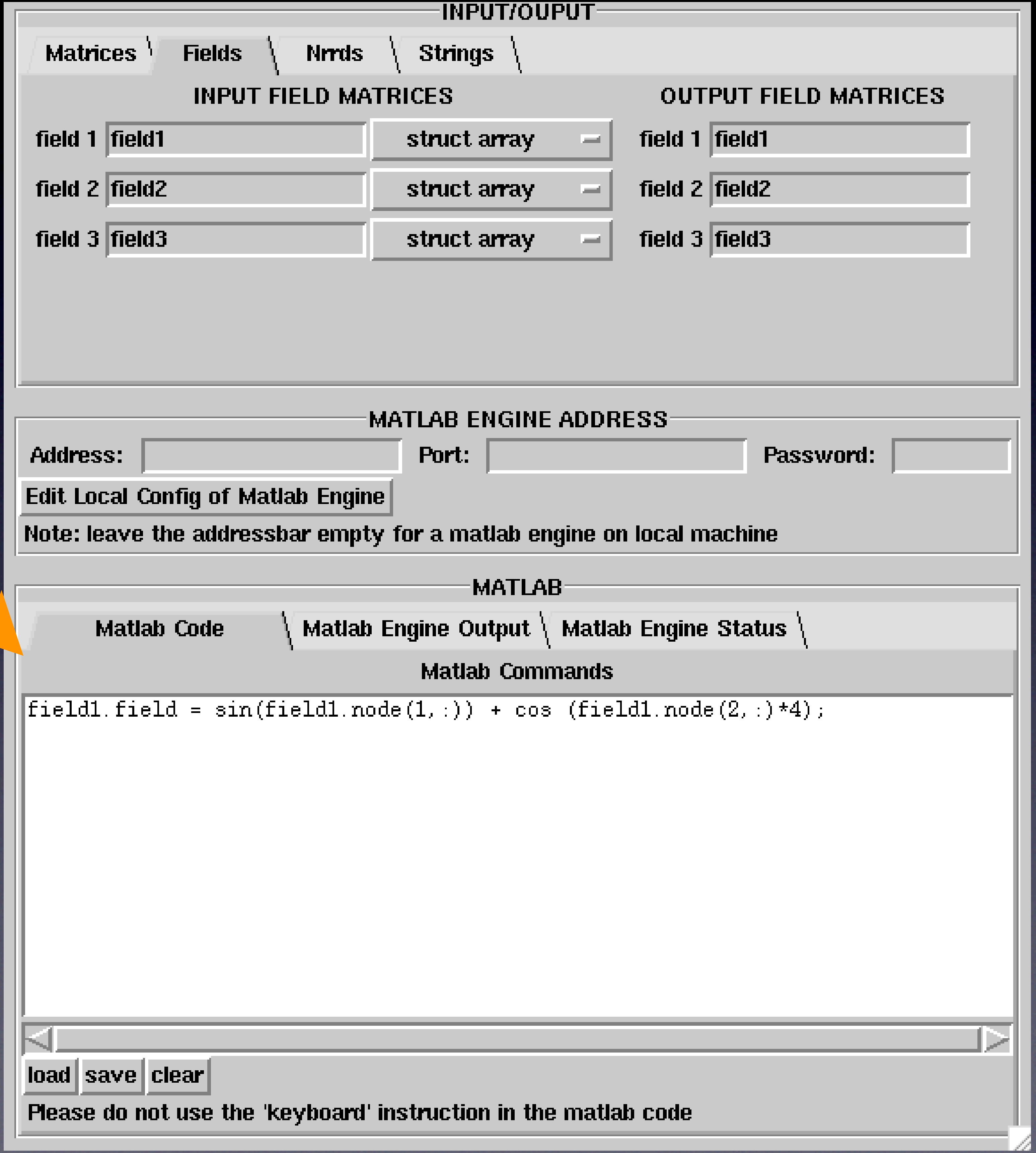
MATLAB

Enter Matlab code here

Please do not use the 'keyboard' instruction in the matlab code

Example interactive function in SCIRun




INPUT/OUPUT

INPUT FIELD MATRICES			OUTPUT FIELD MATRICES	
field 1	field1	struct array	field 1	field1
field 2	field2	struct array	field 2	field2
field 3	field3	struct array	field 3	field3

MATLAB ENGINE ADDRESS

Address: Port: Password:

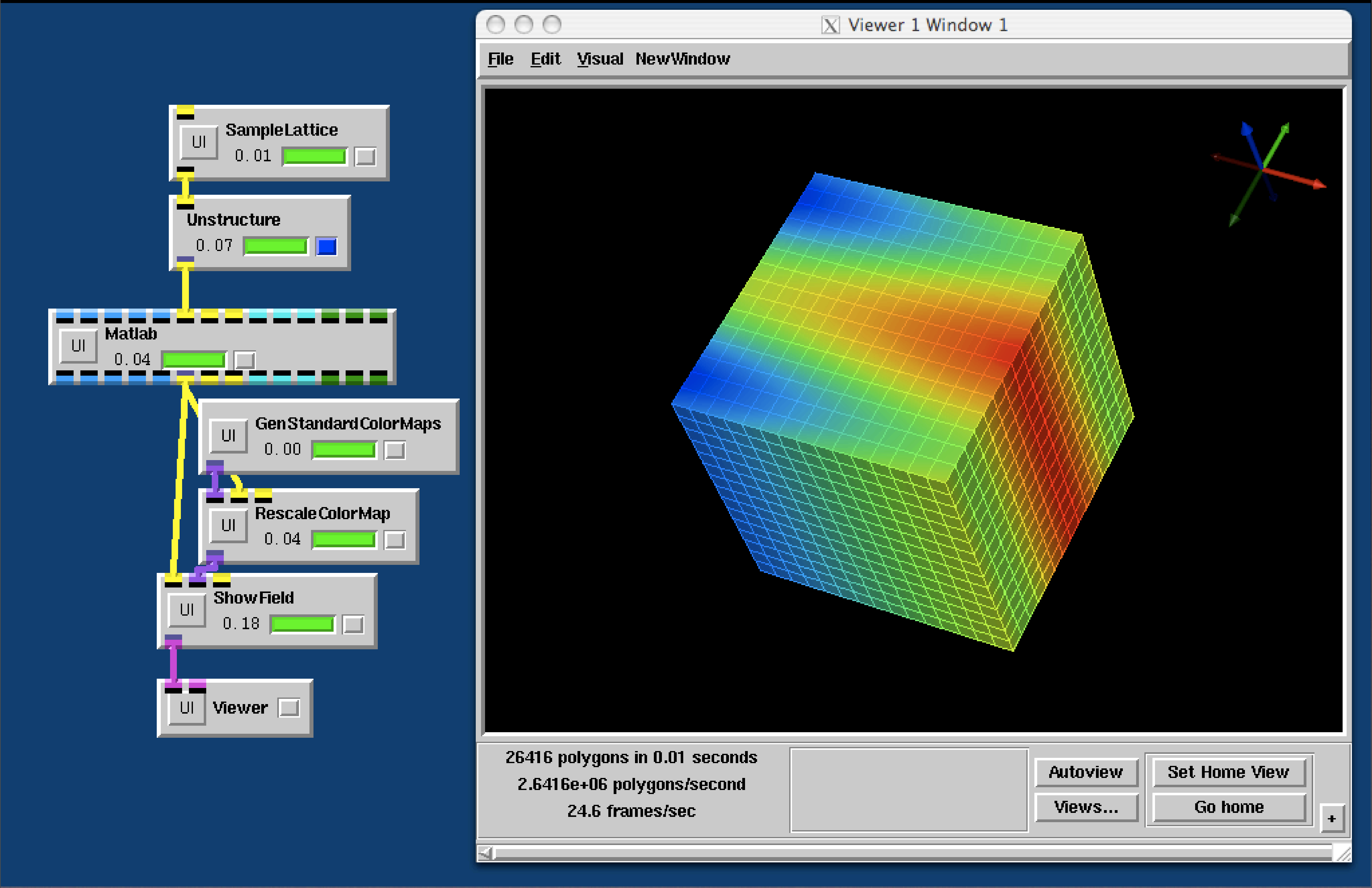
Note: leave the addressbar empty for a matlab engine on local machine

MATLAB

Matlab Commands

```
field1.field = sin(field1.node(1,:)) + cos (field1.node(2,:)*4);
```

Please do not use the 'keyboard' instruction in the matlab code



```
26416 polygons in 0.01 seconds
2.6416e+06 polygons/second
24.6 frames/sec
```

Questions/Support?

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