



Tutorial de Desenvolvimento do *Slicer*: Programando no *Slicer*

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Escola de Medicina de Harvard

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Arquiteto-chefe do 3D Slicer
Isomics Inc.

Objetivo do Tutorial



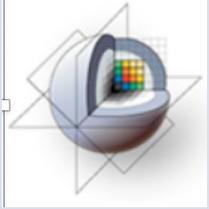
```
def threshold(t):  
    n=getNode('T2')  
    a=array('T2')  
    a[a<t]=0  
    arrayFromVolumeModified(n)  
    print('Thresholding done')
```



```
b=qt.QPushButton('Toggle')  
b.connect('clicked()',toggle)  
b.styleSheet = "font-size: 24pt; color:  
aqua; margin: 20px"  
b.show()
```

Este tutorial é uma introdução ao *Python interactor* e ao conjunto de *widgets Qt* na versão 5 do 3D Slicer.

Roteiro do Tutorial



Parte 1: Visão Geral dos Módulos do 3D Slicer



Parte 2: Familiarizando-se com o ambiente Python no 3D Slicer

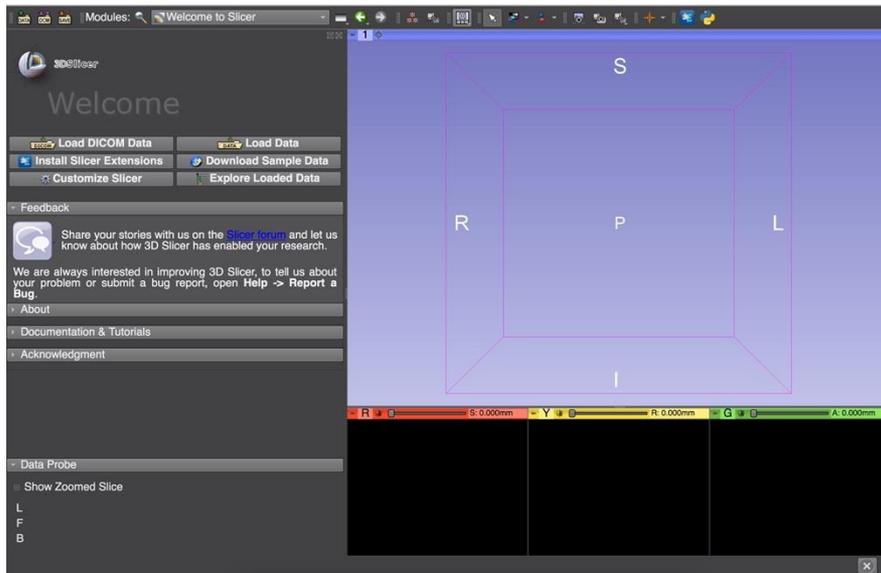


Parte 3: Familiarizando-se com o conjunto de widgets Qt no 3D Slicer

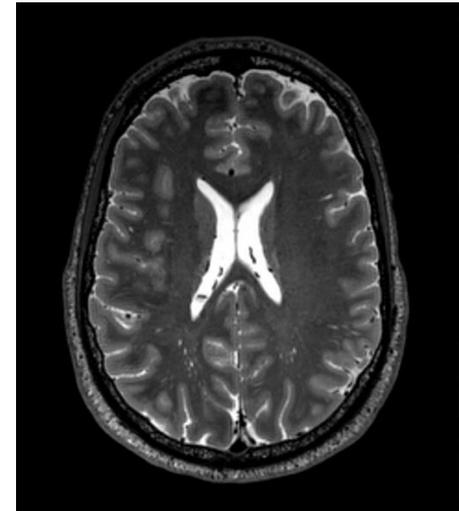
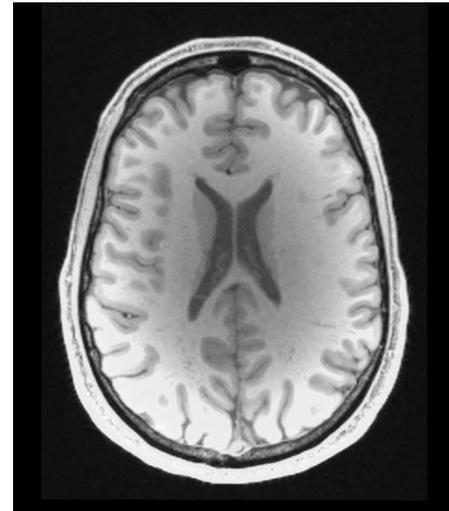
Aviso

- O 3D Slicer é um *software* livre de código aberto distribuído sob uma licença no estilo BSD.
- O *software* não é aprovado pela FDA nem possui marcação CE, sendo destinado apenas para uso em pesquisa.

Materiais de Tutorial



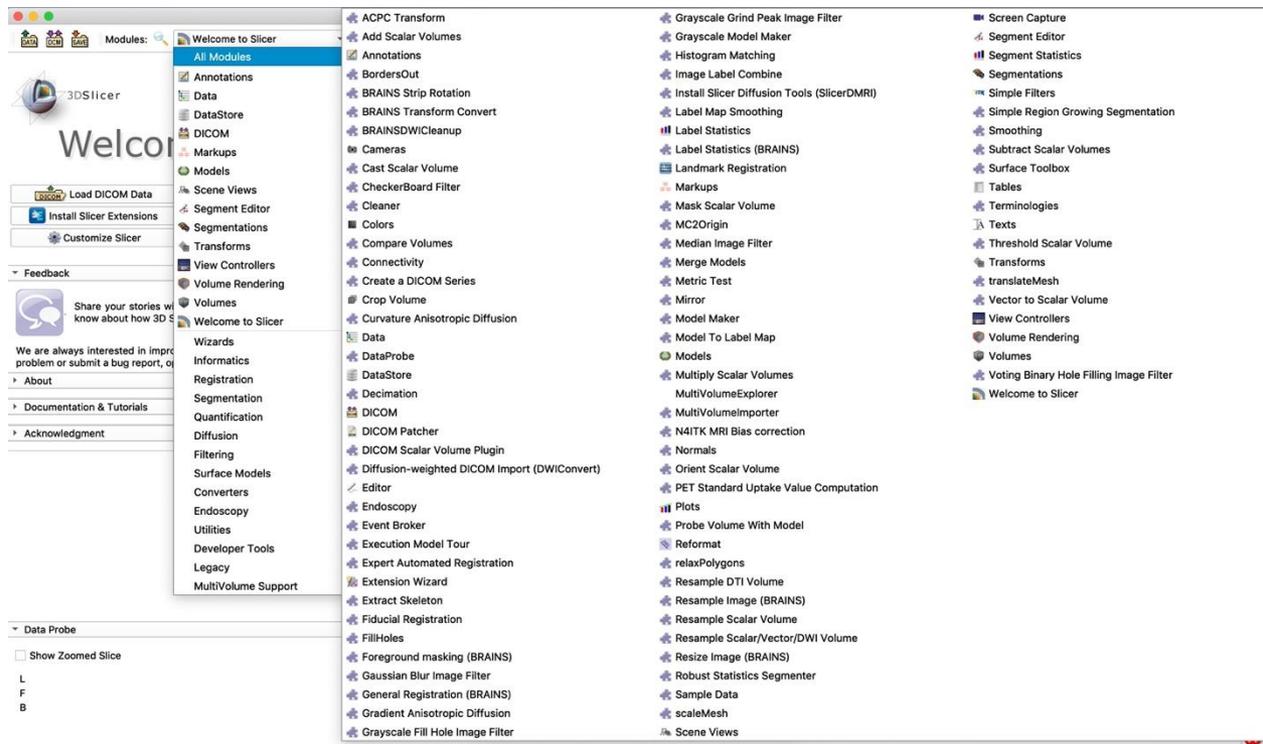
3D Slicer versão 5



SlicerProgrammingTutorialData.zip

Parte 1

Um panorama dos módulos do Slicer



3D Slicer

<> Code Issues 544 Pull requests 52 Actions Wiki Security Insights

Slicer Public Watch 43 Fork 575 Star 1.8k

main 12 Branches 35 Tags Go to file Add file Code

JamesButler and jcf: ENH: Make NSIS Windows installer prettier with applic... 1869775 · 15 hours ago 29,614 Commits

.github	COMP: Bump github/codeql-action from 3.28.1 to 3.28.5	3 days ago
Applications	ENH: Make NSIS Windows installer prettier with application ...	15 hours ago
Base	COMP: Fix Windows build errors by explicitly including Windo...	16 hours ago
CMake	ENH: Make NSIS Windows installer prettier with application ...	15 hours ago
Docs	DOC: Update Transforms module API documentation adding...	5 days ago
Extensions	COMP: Update CLI modules for compatibility with modern IT...	2 days ago

About Multi-platform, free open source software for visualization and image computing. www.slicer.org

python c-plus-plus qt image-processing medical-imaging registration neuroimaging segmentation vtk itk national-institutes-of-health medical-image-computing 3d-printing 3d-slicer tractography image-guided-therapy nih computed-tomography kitware tcia-dac

- O 3D Slicer é uma plataforma de código aberto para análise e visualização de dados de imagens médicas.
- O 3D Slicer é compilado e testado todos os dias nas plataformas Windows, Mac e Linux.
- O código-fonte está disponível gratuitamente no GitHub em <http://github.com/Slicer/Slicer>.

Módulos do Slicer

O 3D Slicer suporta três tipos de módulos:

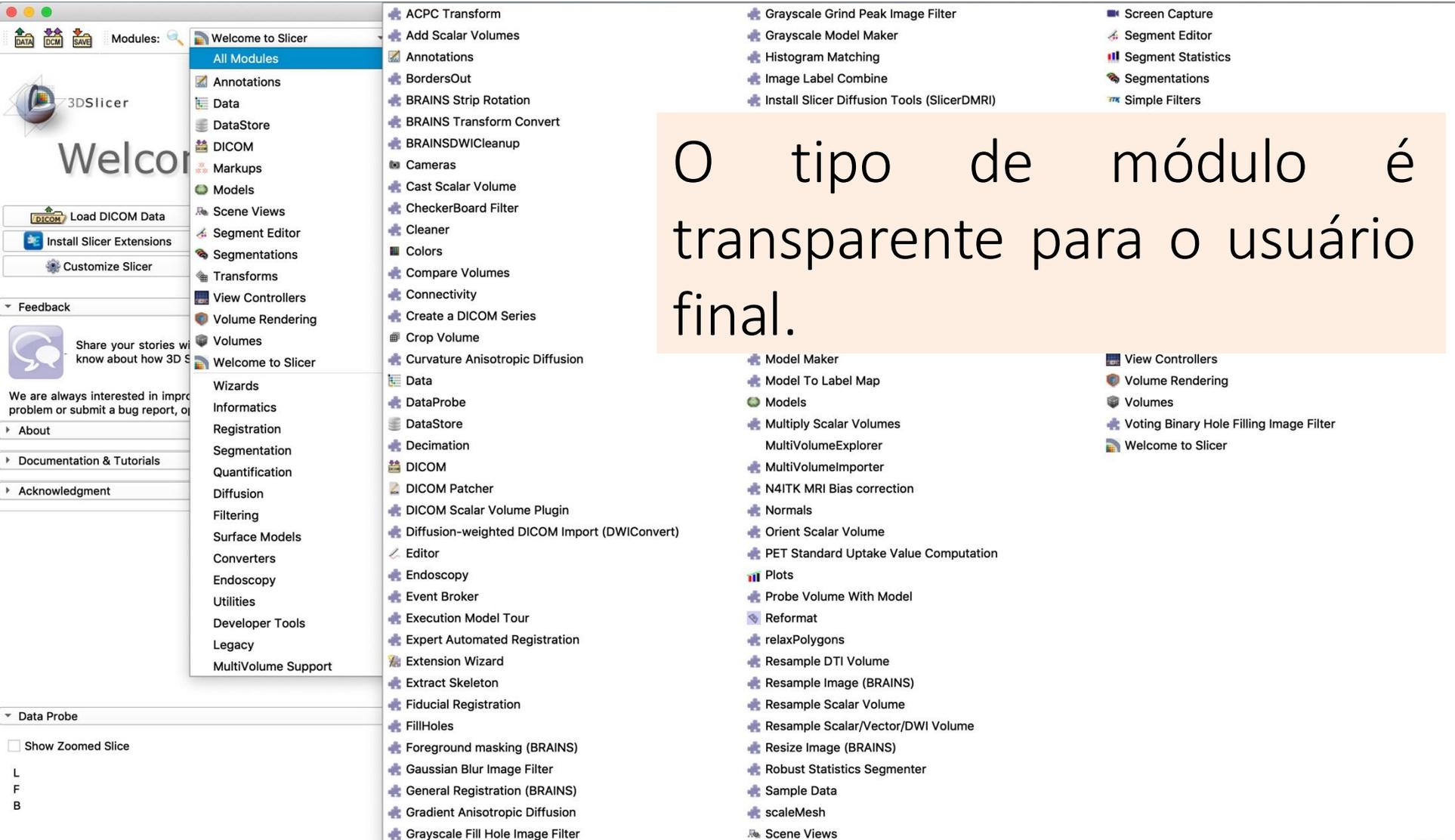
Command-line Interface (CLI) [Interface de Linha de Comando]: executável independente com argumentos de entrada/saída limitados.

Módulos Carregáveis (Plugins em C++): otimizados para computação pesada.

Foco deste tutorial

- Módulos com *scripts* (Python): recomendados para prototipagem rápida e desenvolvimento de fluxos de trabalho.

Módulos do Slicer



The image shows the Slicer software interface with the 'Modules' list expanded on the left. The list includes various modules such as ACPC Transform, Add Scalar Volumes, Annotations, BordersOut, BRAINS Strip Rotation, BRAINS Transform Convert, BRAINSDWICleanup, Cameras, Cast Scalar Volume, CheckerBoard Filter, Cleaner, Colors, Compare Volumes, Connectivity, Create a DICOM Series, Crop Volume, Curvature Anisotropic Diffusion, Data, DataProbe, DataStore, Decimation, DICOM, DICOM Patcher, DICOM Scalar Volume Plugin, Diffusion-weighted DICOM Import (DWIConvert), Editor, Endoscopy, Event Broker, Execution Model Tour, Expert Automated Registration, Extension Wizard, Extract Skeleton, Fiducial Registration, FillHoles, Foreground masking (BRAINS), Gaussian Blur Image Filter, General Registration (BRAINS), Gradient Anisotropic Diffusion, Grayscale Fill Hole Image Filter, Grayscale Grind Peak Image Filter, Grayscale Model Maker, Histogram Matching, Image Label Combine, Install Slicer Diffusion Tools (SlicerDMRI), Model Maker, Model To Label Map, Models, Multiply Scalar Volumes, MultiVolumeExplorer, MultiVolumeImporter, N4ITK MRI Bias correction, Normals, Orient Scalar Volume, PET Standard Uptake Value Computation, Plots, Probe Volume With Model, Reformat, relaxPolygons, Resample DTI Volume, Resample Image (BRAINS), Resample Scalar Volume, Resample Scalar/Vector/DWI Volume, Resize Image (BRAINS), Robust Statistics Segmenter, Sample Data, scaleMesh, Scene Views, Screen Capture, Segment Editor, Segment Statistics, Segmentations, Simple Filters, View Controllers, Volume Rendering, Volumes, Voting Binary Hole Filling Image Filter, and Welcome to Slicer.

O tipo de módulo é transparente para o usuário final.

Extensões do Slicer

Uma Extensão do Slicer é um pacote de distribuição que agrupa um ou mais módulos do Slicer.



SwissSkullStripper
Bill Lorensen (Noware...
★★★★★ (0)

INSTALL



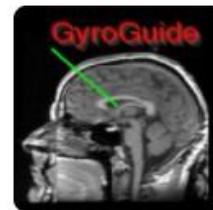
PETTumorSegmenta...
Christian Bauer (Univ...
★★★★★ (0)

INSTALL



SlicerOpenIGTLink
Junichi Tokuda (SPL), ...
★★★★★ (0)

INSTALL



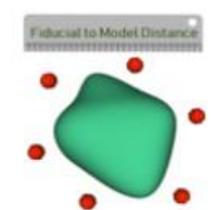
GyroGuide
Ruifeng Chen, Luping...
★★★★★ (0)

INSTALL



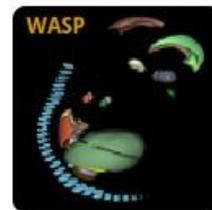
PET-IndiC
Ethan Ulrich (Universi...
★★★★★ (0)

INSTALL



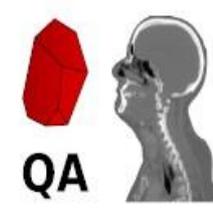
FiducialsToModelDi...
Jesse Reynolds (Cante...
★★★★★ (0)

INSTALL



Slicer-Wasp
Thomas Lawson (MR...
★★★★★ (0)

INSTALL

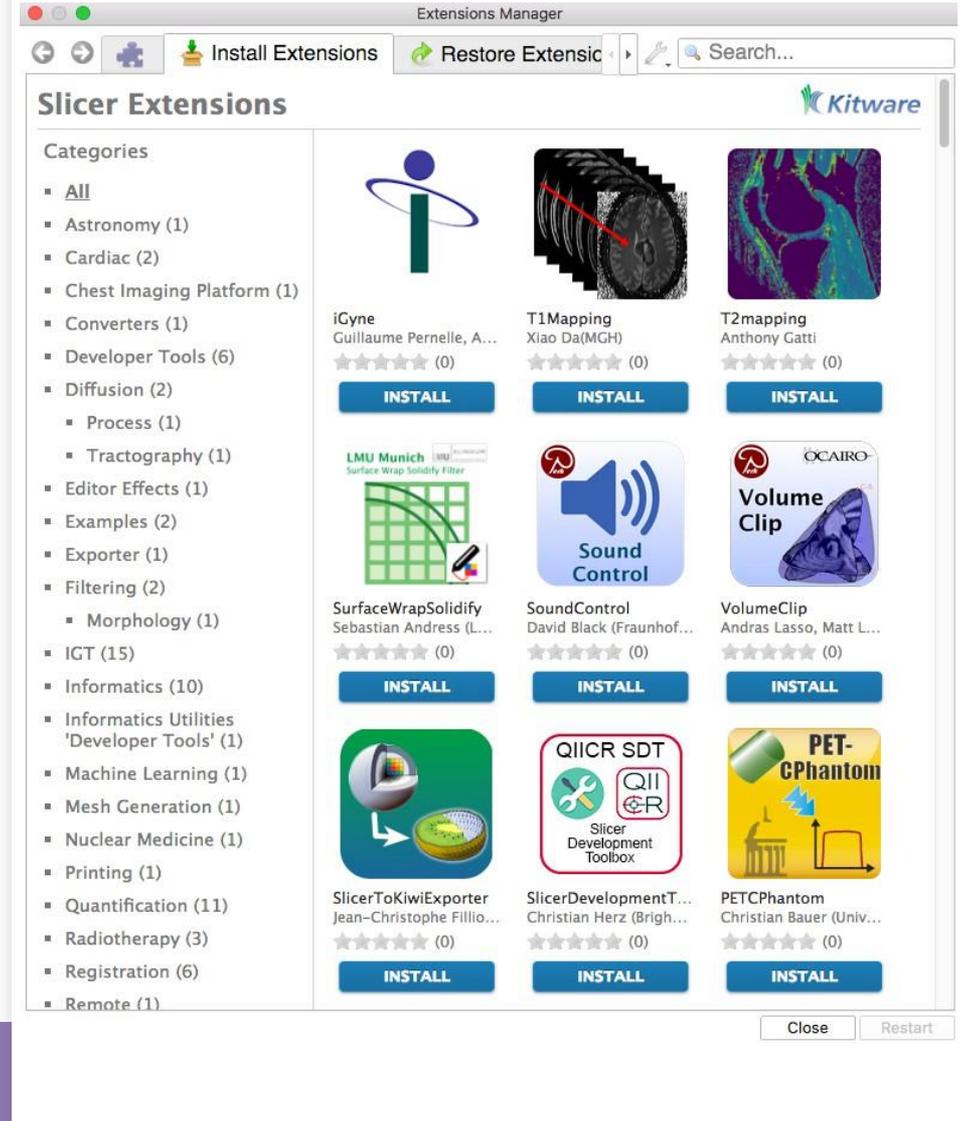


ImageCompare
Paolo Zaffino (Magna ...
★★★★★ (0)

INSTALL

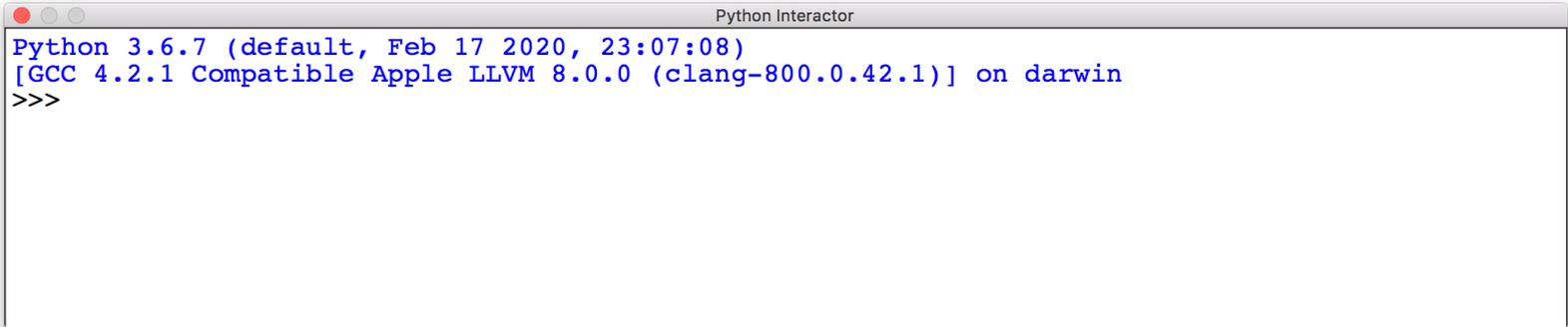
Gerenciador de Extensões do Slicer

- O Gerenciador de Extensões do Slicer oferece uma plataforma do tipo “loja de aplicativos” para o ecossistema do 3D Slicer.
- O Gerenciador de Extensões permite a criação e a instalação fácil de extensões do Slicer.
- A versão de lançamento do Slicer 5 inclui mais de 130 extensões.



Parte 2

Familiarizando-se com o ambiente Python no 3D Slicer



```
Python Interactor
Python 3.6.7 (default, Feb 17 2020, 23:07:08)
[GCC 4.2.1 Compatible Apple LLVM 8.0.0 (clang-800.0.42.1)] on darwin
>>>
```

Python no Slicer

O Slicer v. 5 funciona com Python 3 e um conjunto rico de bibliotecas padrão.



O NumPy é o pacote fundamental para a computação científica com Python.



O VTK é uma biblioteca de código aberto para manipulação e apresentação de dados científicos.



O ITK é uma biblioteca de código aberto para análise de imagens.



CTK é uma biblioteca de código aberto para a computação de imagens biomédicas.



PythonQt é uma ligação Python para Qt.

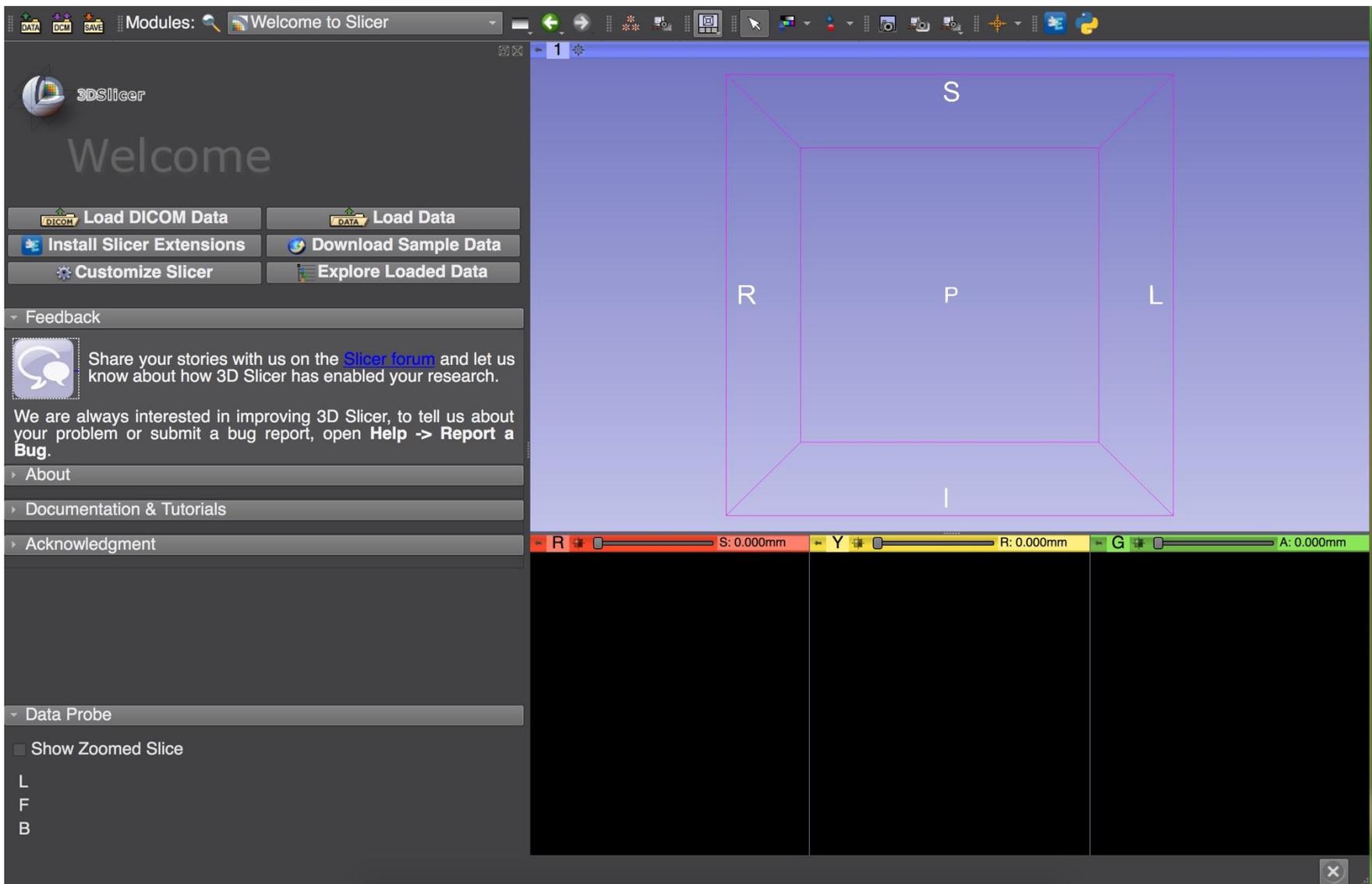


O Qt é uma estrutura multiplataforma utilizada como um conjunto de ferramentas gráficas.

Python no Slicer



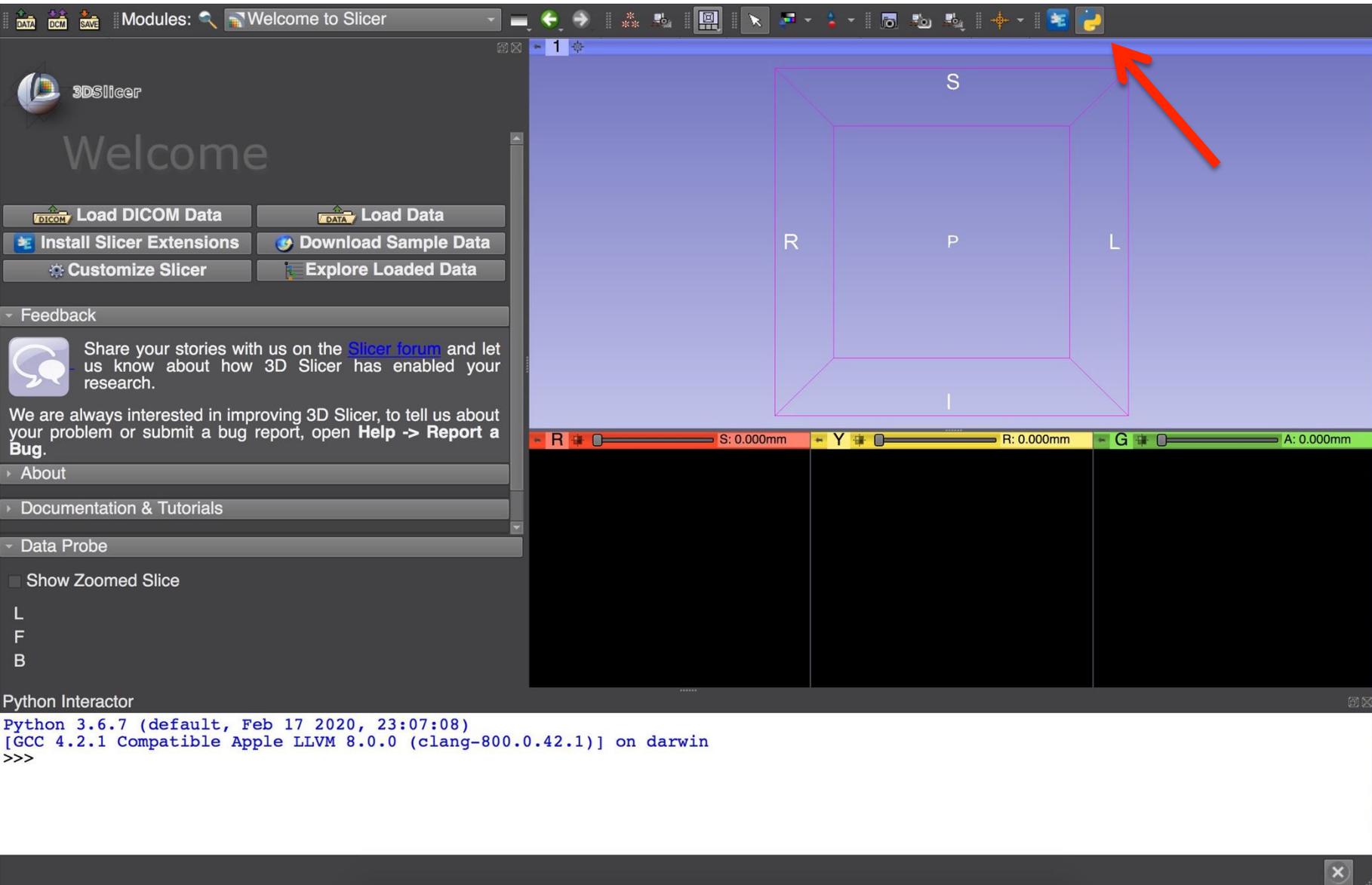
- O índice de pacotes Python (PyPi) dá acesso a mais de 200.000 pacotes Python adicionais (<http://pipy.org>).
- O comando *pip install* no Slicer permite que os programadores instalem as ferramentas de computação científica mais comuns (por exemplo, *TensorFlow*, *SciPy*, *PyTorch*, *Pandas* etc.).
- O Slicer pode ser usado como um *kernel* do *Jupyter Notebook*.
- PyCharm e outras ferramentas de desenvolvimento Python podem ser usadas com o Slicer.



A versão 5 do Slicer integra Python3, VTK5 e ITK5

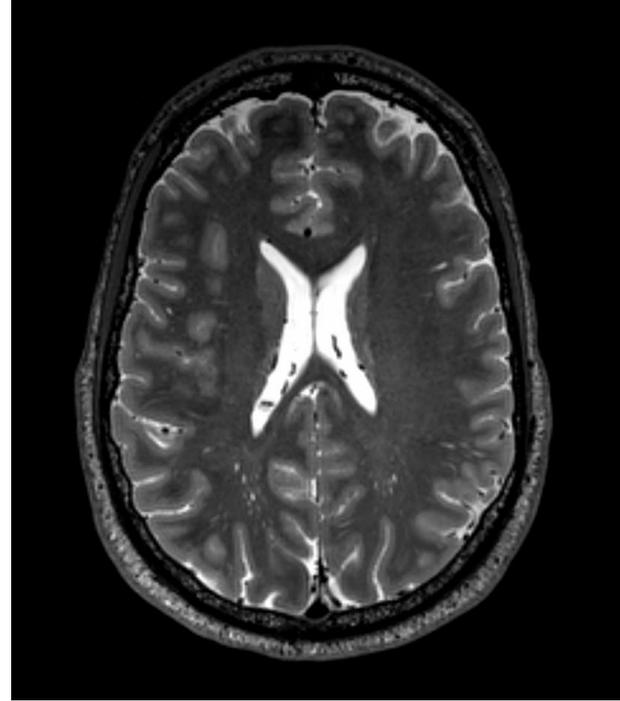
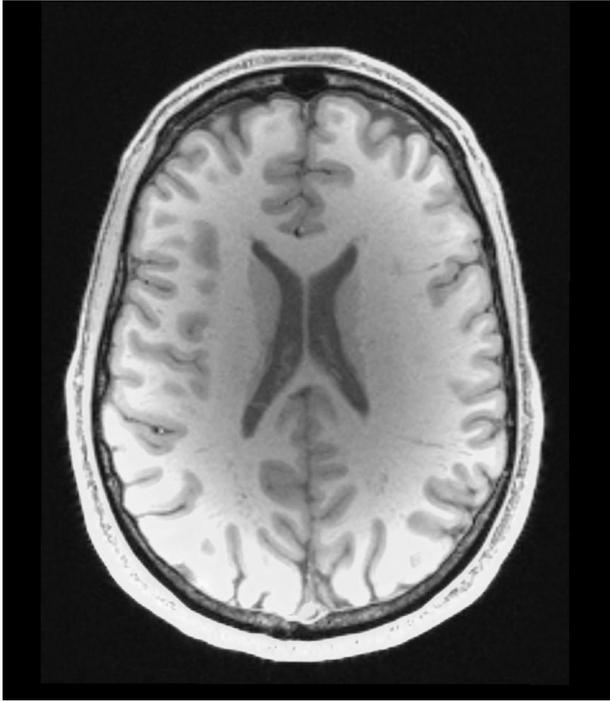
O console Python no Slicer

O Python Interactor é um console baseado em Qt que permite acesso direto aos Nós MRML do Slicer, a bibliotecas (NumPy, VTK, ITK, CTK) e ao Qt.



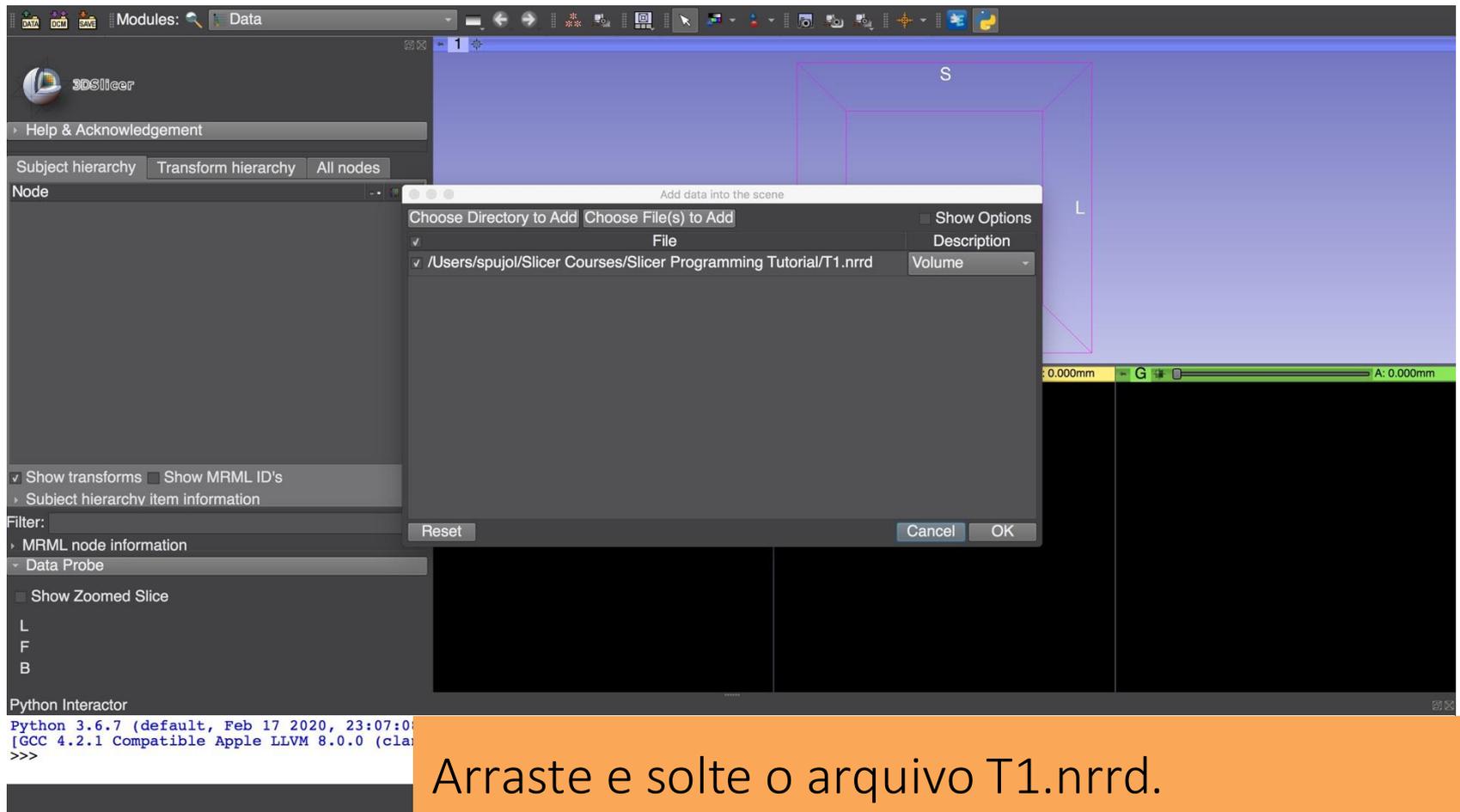
Para acessar o Python Interactor, clique no ícone do Python no menu da barra superior do Slicer.





O conjunto de dados do tutorial de programação do Slicer inclui exames de ressonância magnética ponderados em T1 e T2 de um sujeito saudável.

Conjunto de dados do tutorial



Arraste e solte o arquivo T1.nrrd.

Clique em OK para carregar o arquivo no Slicer.

Conjunto de dados do tutorial

The image shows the 3DSlicer software interface. The main window displays a 3D coordinate system with axes labeled S (Superior), I (Inferior), R (Right), and L (Left). Below the 3D view, there are three orthogonal slices: an axial slice (left), a sagittal slice (middle), and a coronal slice (right). The slice positions are indicated by sliders at the bottom of the 3D view, showing S: 12.971mm, R: 3.818mm, and A: 21.967mm.

The left sidebar contains the following sections:

- Help & Acknowledgement
- Subject hierarchy (T1)
- Transform hierarchy
- All nodes
- Node: T1
- Show transforms (checked)
- Show MRML ID's (unchecked)
- Subject hierarchy item information
- Filter: MRML node information
- Data Probe
- Show Zoomed Slice (unchecked)
- L
- F
- B

The bottom of the interface shows a Python Interactor window with the following text:

```
Python 3.6.7 (default, Mar 10 2020, 23:07:26)  
[GCC 4.2.1 Compatible Apple LLVM 8.0.0 (clang-800.0.42.1)] on darwin  
>>>
```

Visão Geral

- O Slicer é um *software* livre e de código aberto.
- Há milhares de imagens médicas sofisticadas disponíveis na *internet* que você pode visualizar e analisar com o 3D Slicer.

Modelo de Dados do Slicer



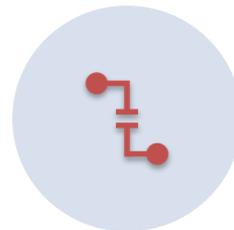
O Modelo de Dados do Slicer é baseado na Estrutura de Dados da Cena do Slicer.



A *Medical Reality Markup Language* (MRML) [Linguagem de Marcação da Realidade Médica] é uma linguagem baseada em XML usada para serializar o conteúdo da cena do Slicer no disco (scene.mrml).



Uma cena do Slicer é uma coleção de imagens, anotações, modelos 3D, transformações espaciais, marcas de referência e câmeras.



Cada elemento de uma cena é chamado de nó MRML.

Nós MRML do Slicer: Tipos Básicos



Nó de dados: Armazena os dados brutos



Nó de exibição: Descreve como os dados devem ser visualizados



Nó de armazenamento: Descreve como os dados devem ser armazenados no disco

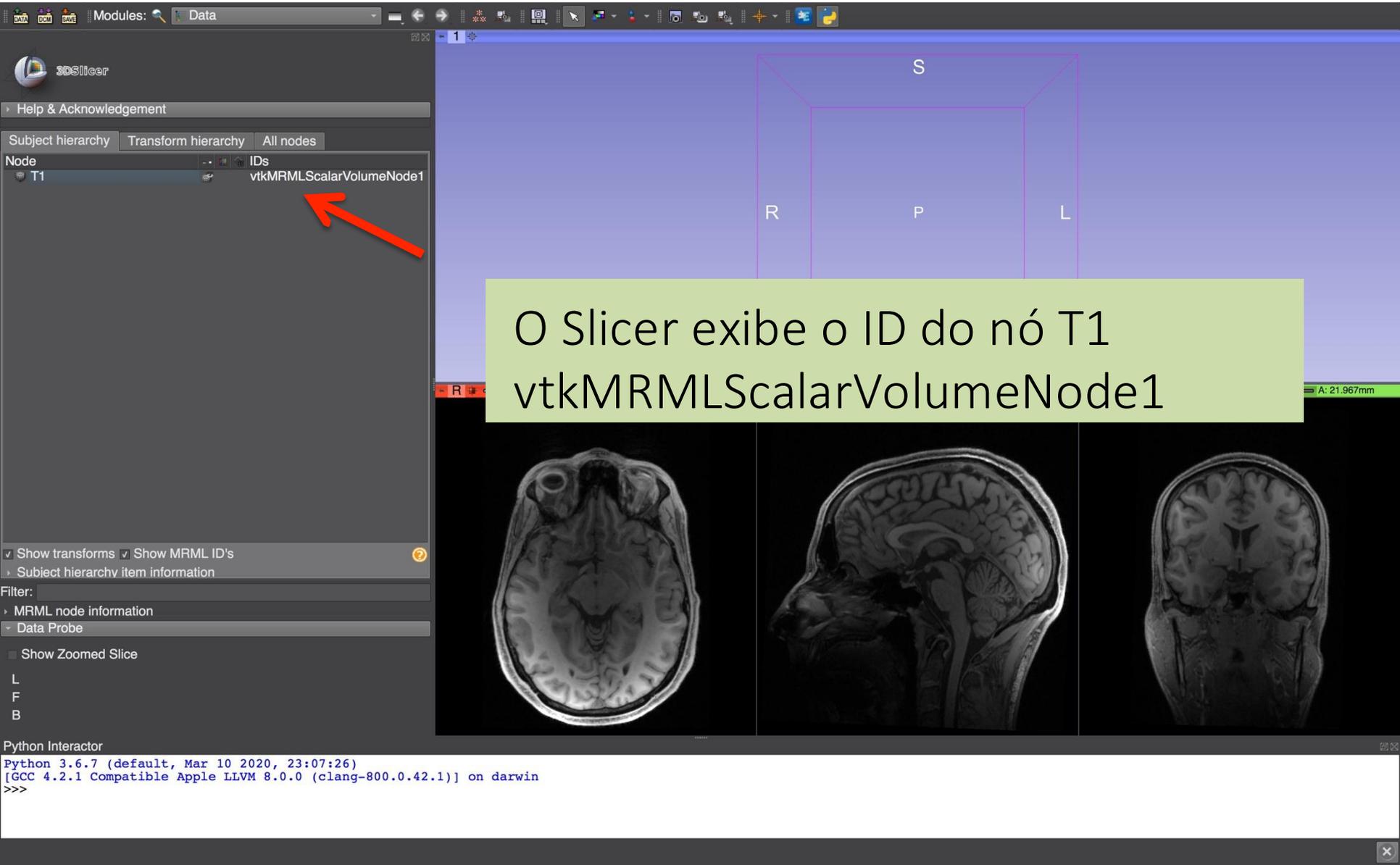
Conjunto de dados do Tutorial

The screenshot displays the 3DSlicer software interface. At the top, there is a menu bar with 'Modules' and 'Data'. Below it is a toolbar with various icons. The main window shows a 3D coordinate system with axes labeled S (Superior), I (Inferior), R (Right), and L (Left). Below the 3D view are three sliders for R (Red), Y (Yellow), and G (Green) channels, with values S: 12.971mm, R: 3.818mm, and A: 21.967mm. At the bottom, there are three MRI brain scan slices: an axial view on the left, a sagittal view in the middle, and a coronal view on the right. On the left side, there is a sidebar with 'Help & Acknowledgement', 'Subject hierarchy', 'Transform hierarchy', and 'All nodes'. Under 'Node', 'T1' is selected. Below this, there are checkboxes for 'Show transforms' (checked) and 'Show MRML ID's' (unchecked). A red arrow points to the 'Show MRML ID's' checkbox. Below the sidebar, there is a 'Filter:' section with 'MRML node information' and 'Data Probe'. At the bottom, there is a 'Python Interactor' window showing the Python version (3.6.7) and the system information (GCC 4.2.1 Compatible Apple LLVM 8.0.0 (clang-800.0.42.1)) on darwin.

Selezione Mostrare IDs MRML.

```
Python 3.6.7 (default, Mar 10 2020, 23:07:26)
[GCC 4.2.1 Compatible Apple LLVM 8.0.0 (clang-800.0.42.1)] on darwin
>>>
```

Modelo de Dados do Slicer



The screenshot displays the Slicer software interface. On the left, the 'All nodes' panel shows a tree structure with a node 'T1' highlighted, and its ID 'vtkMRMLScalarVolumeNode1' is visible. A red arrow points to this ID. The main 3D view shows a purple volume with axes labeled 'S' (Superior), 'R' (Right), and 'L' (Left). Below the 3D view, three MRI slices are shown: axial, sagittal, and coronal. A green text box in the center of the 3D view contains the text: 'O Slicer exibe o ID do nó T1 vtkMRMLScalarVolumeNode1'. The bottom of the interface shows a Python Interactor with the text: 'Python 3.6.7 (default, Mar 10 2020, 23:07:26) [GCC 4.2.1 Compatible Apple LLVM 8.0.0 (clang-800.0.42.1)] on darwin >>>'. The status bar at the bottom right indicates 'A: 21.967mm'.

Acessando nós MRML a partir do Python interactor

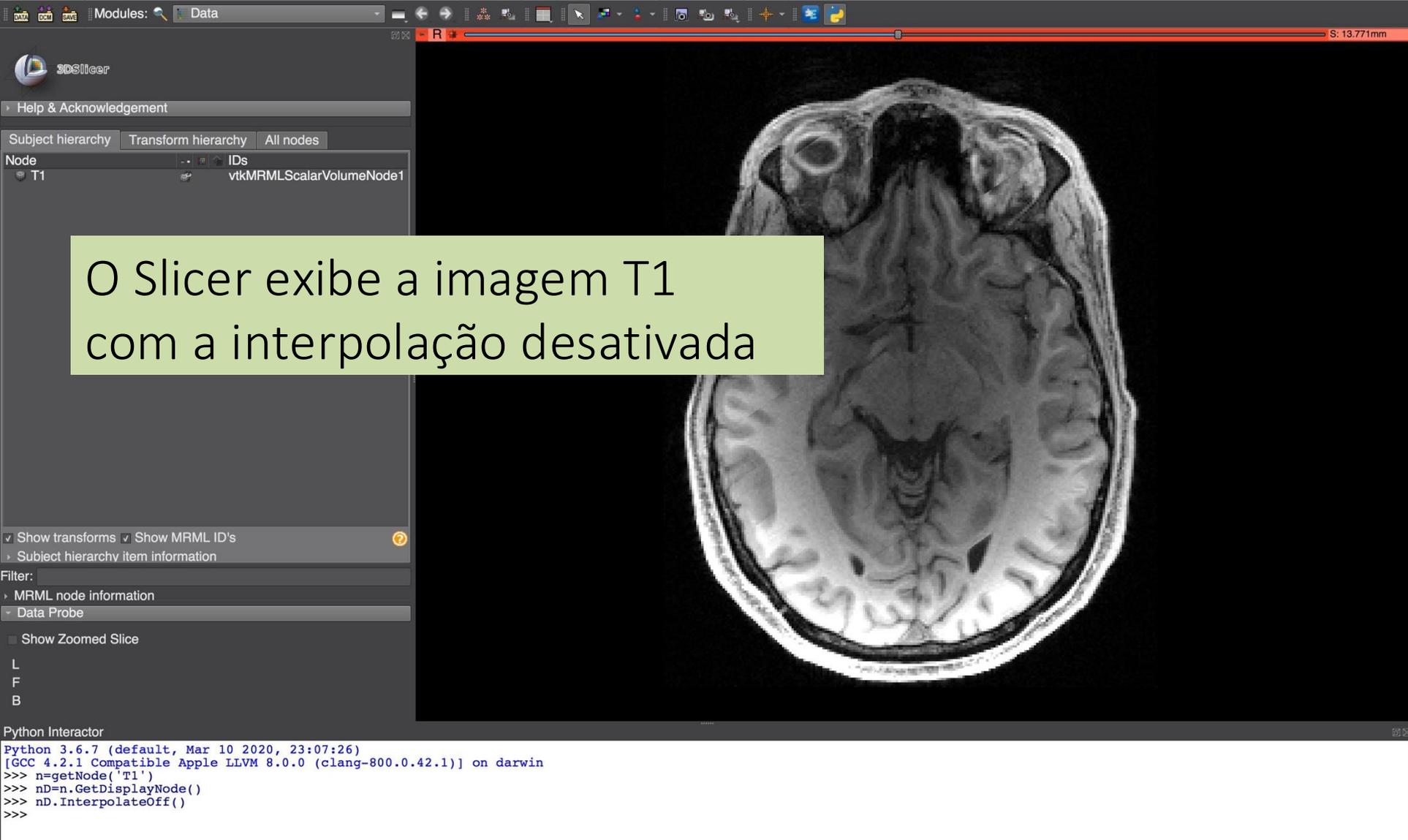
Selecione o *layout* do *Slicer* “Somente fatia vermelha”.

Execute o seguinte comando no console Python:

```
n=getNode('T1')
nD=n.GetDisplayNode()
nD.InterpolateOff()
```

```
Python Interactor
Python 3.6.7 (default, Mar 10 2020, 23:07:26)
[GCC 4.2.1 Compatible Apple LLVM 8.0.0 (clang-800.0.42.1)] on darwin
>>> n=getNode('T1')
>>> nD=n.GetDisplayNode()
>>> nD.InterpolateOff()
>>>
```

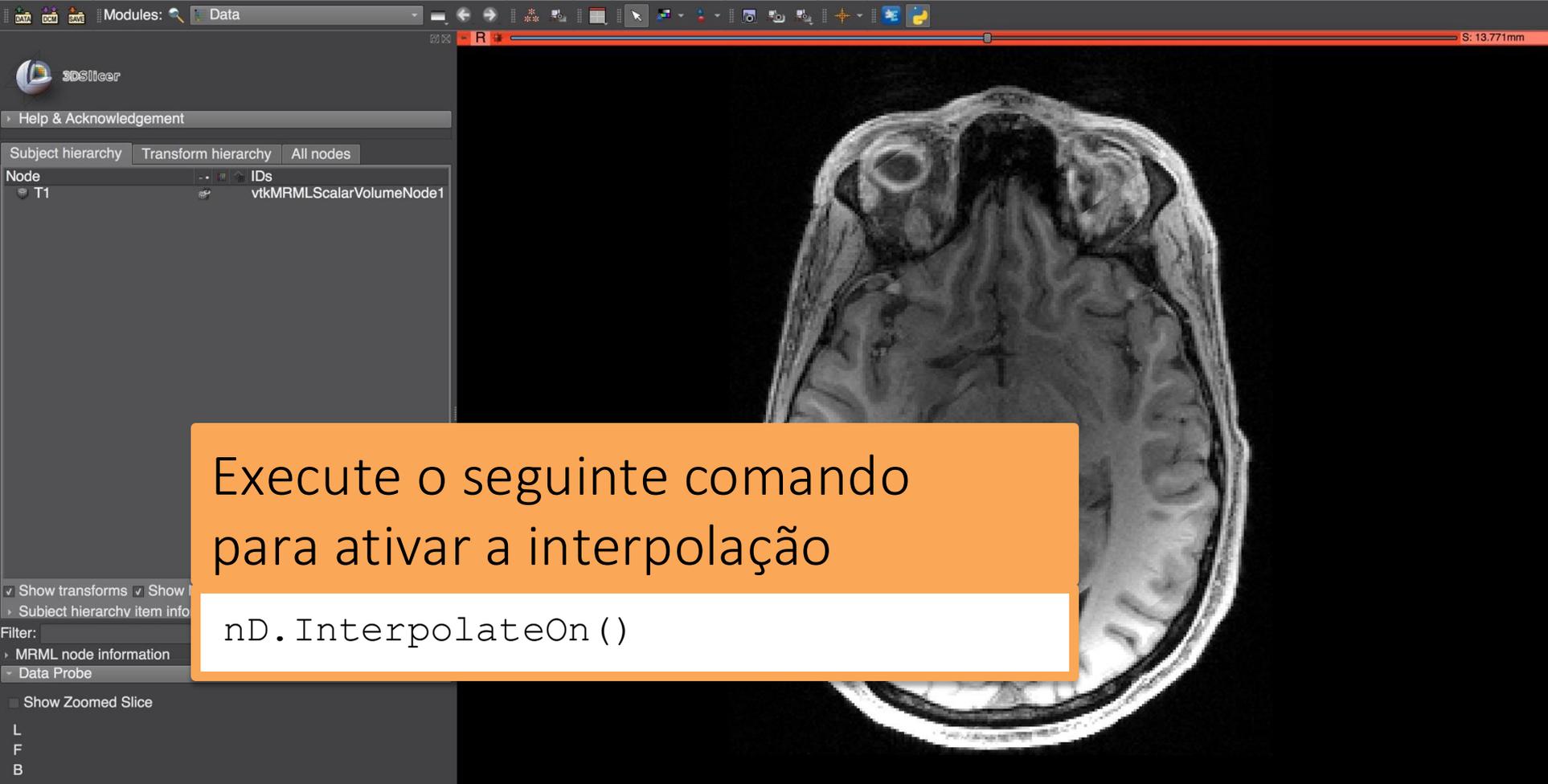
Acessando nós MRML a partir do Python interactor



O Slicer exibe a imagem T1 com a interpolação desativada

```
Python Interactor
Python 3.6.7 (default, Mar 10 2020, 23:07:26)
[GCC 4.2.1 Compatible Apple LLVM 8.0.0 (clang-800.0.42.1)] on darwin
>>> n=getNode('T1')
>>> nD=n.GetDisplayNode()
>>> nD.InterpolateOff()
>>>
```

Acessando nós MRML a partir do Python interactor

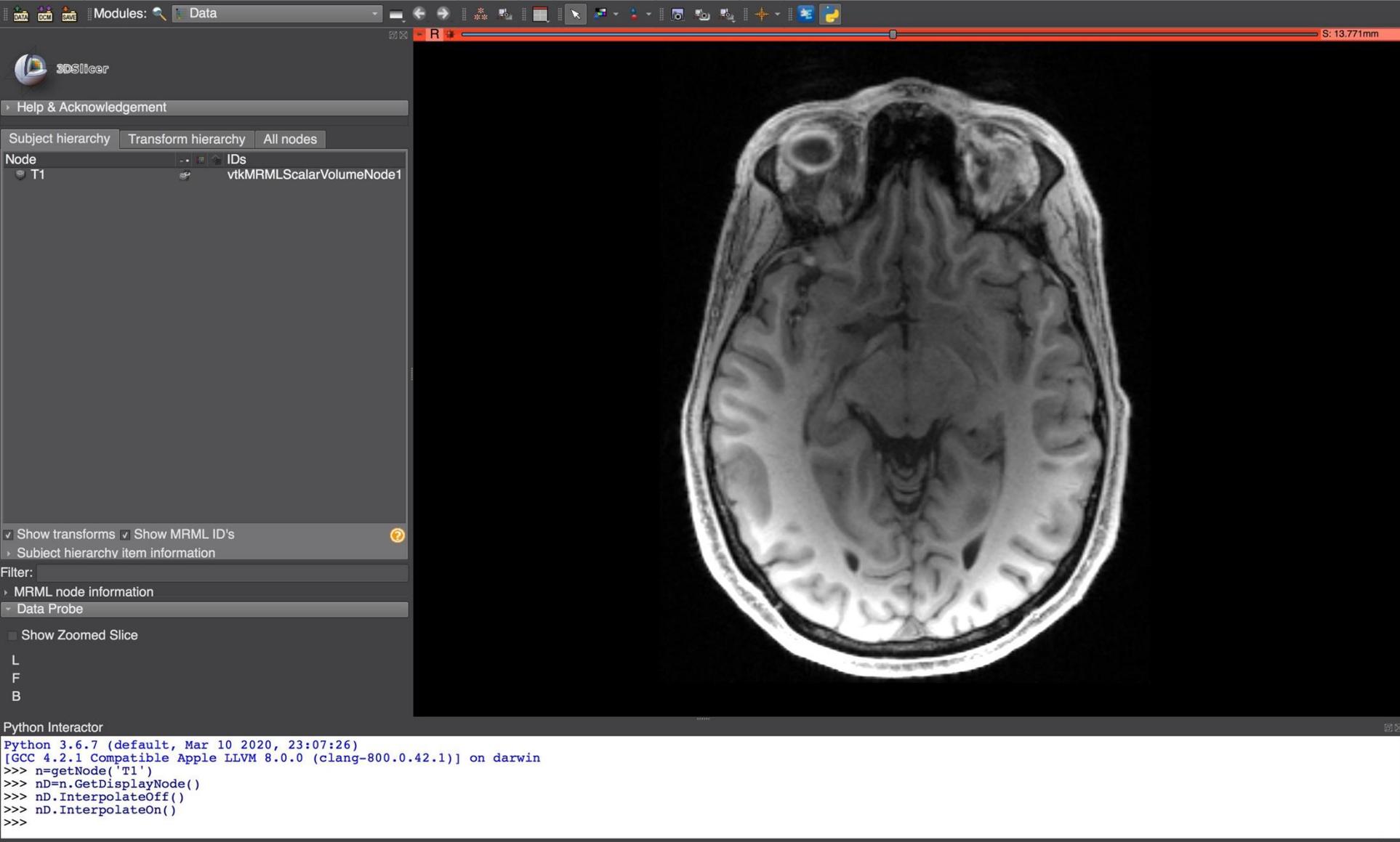


Execute o seguinte comando para ativar a interpolação

```
nD.InterpolateOn()
```

```
Python 3.6.7 (default, Mar 10 2020, 23:07:26)
[GCC 4.2.1 Compatible Apple LLVM 8.0.0 (clang-800.0.42.1)] on darwin
>>> n=getNode('T1')
>>> nD=n.GetDisplayNode()
>>> nD.InterpolateOff()
>>>
```

Acessando nós MRML a partir do Python interactor



The screenshot displays the 3D Slicer software interface. The main window shows an axial MRI slice of a brain. The left sidebar contains a 'Node' list with 'T1' selected, showing its ID as 'vtkMRMLScalarVolumeNode1'. Below the node list, there are checkboxes for 'Show transforms', 'Show MRML ID's', and 'Show Zoomed Slice'. The 'Python Interactor' window at the bottom shows the following code:

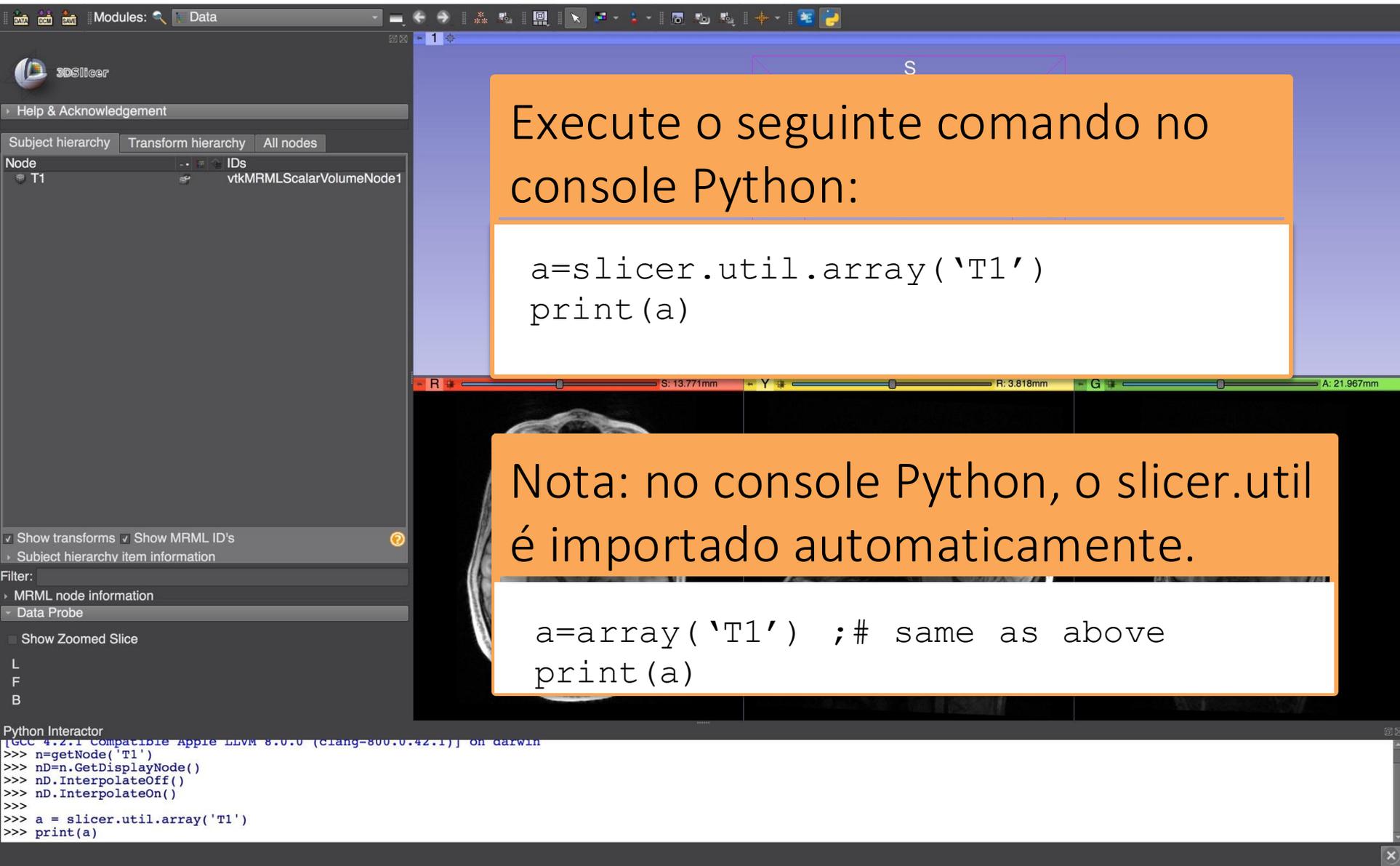
```
Python 3.6.7 (default, Mar 10 2020, 23:07:26)
[GCC 4.2.1 Compatible Apple LLVM 8.0.0 (clang-800.0.42.1)] on darwin
>>> n=getNode('T1')
>>> nd=n.GetDisplayNode()
>>> nd.InterpolateOff()
>>> nd.InterpolateOn()
>>>
```

Acessando vóxeis em um volume

- O pacote `slicer.util` oferece acesso aos volumes como *arrays* multidimensionais do *NumPy*.
- Os volumes podem ser modificados utilizando métodos padrão do *NumPy*.



Acessando vóxeis em um volume



The image shows a screenshot of the Slicer software interface. On the left, there is a sidebar with a 'Subject hierarchy' panel showing a tree structure with a node 'T1' of type 'vtkMRMLScalarVolumeNode1'. Below this is a 'Python Interactor' window with a terminal-like interface. The main window displays a 3D view of a volume with a red box highlighting a slice. The slice is labeled 'S' and has a value of 13.771mm. The volume is also labeled 'S' and has a value of 3.818mm. The slice is also labeled 'G' and has a value of 21.967mm. The volume is also labeled 'R' and has a value of 13.771mm. The volume is also labeled 'Y' and has a value of 3.818mm. The volume is also labeled 'A' and has a value of 21.967mm.

Execute o seguinte comando no console Python:

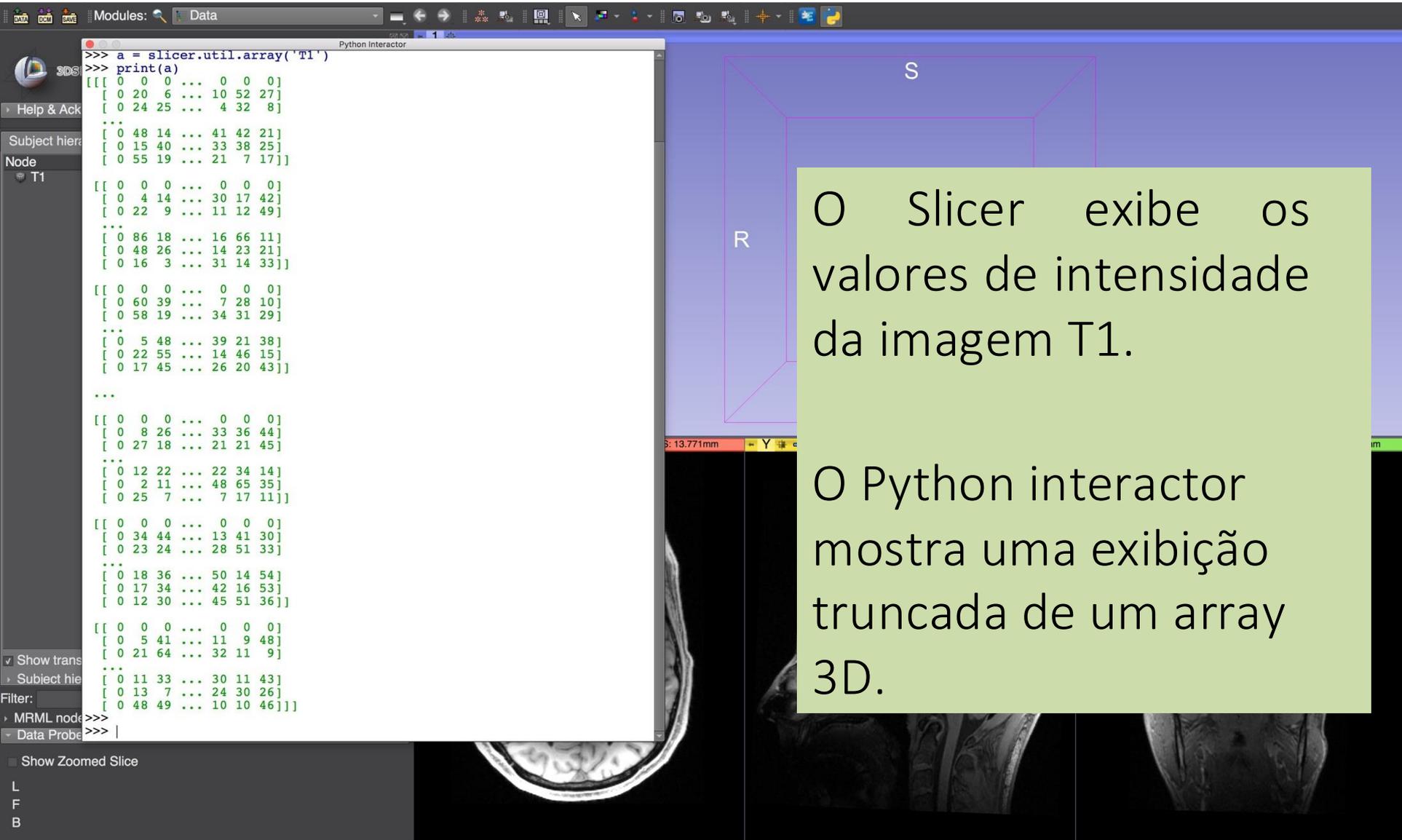
```
a=slicer.util.array('T1')
print(a)
```

Nota: no console Python, o slicer.util é importado automaticamente.

```
a=array('T1') ;# same as above
print(a)
```

```
Python Interactor
[GCC 4.2.1 Compatible Apple LLVM 8.0.0 (clang-800.0.42.1)] on darwin
>>> n=getNode('T1')
>>> nD=n.GetDisplayNode()
>>> nD.InterpolateOff()
>>> nD.InterpolateOn()
>>>
>>> a = slicer.util.array('T1')
>>> print(a)
```

Acessando vóxeis em um volume



The image shows a screenshot of the Slicer software interface. On the left, a Python Interactor window displays the following code and output:

```
>>> a = slicer.util.array('T1')
>>> print(a)
[[[ 0  0  0 ...  0  0  0]
 [ 0 20  6 ... 10 52 27]
 [ 0 24 25 ...  4 32  8]
 ...
 [ 0 48 14 ... 41 42 21]
 [ 0 15 40 ... 33 38 25]
 [ 0 55 19 ... 21  7 17]]]

[[[ 0  0  0 ...  0  0  0]
 [ 0  4 14 ... 30 17 42]
 [ 0 22  9 ... 11 12 49]
 ...
 [ 0 86 18 ... 16 66 11]
 [ 0 48 26 ... 14 23 21]
 [ 0 16  3 ... 31 14 33]]]

[[[ 0  0  0 ...  0  0  0]
 [ 0 60 39 ...  7 28 10]
 [ 0 58 19 ... 34 31 29]
 ...
 [ 0  5 48 ... 39 21 38]
 [ 0 22 55 ... 14 46 15]
 [ 0 17 45 ... 26 20 43]]]

...

[[[ 0  0  0 ...  0  0  0]
 [ 0  8 26 ... 33 36 44]
 [ 0 27 18 ... 21 21 45]
 ...
 [ 0 12 22 ... 22 34 14]
 [ 0  2 11 ... 48 65 35]
 [ 0 25  7 ...  7 17 11]]]

[[[ 0  0  0 ...  0  0  0]
 [ 0 34 44 ... 13 41 30]
 [ 0 23 24 ... 28 51 33]
 ...
 [ 0 18 36 ... 50 14 54]
 [ 0 17 34 ... 42 16 53]
 [ 0 12 30 ... 45 51 36]]]

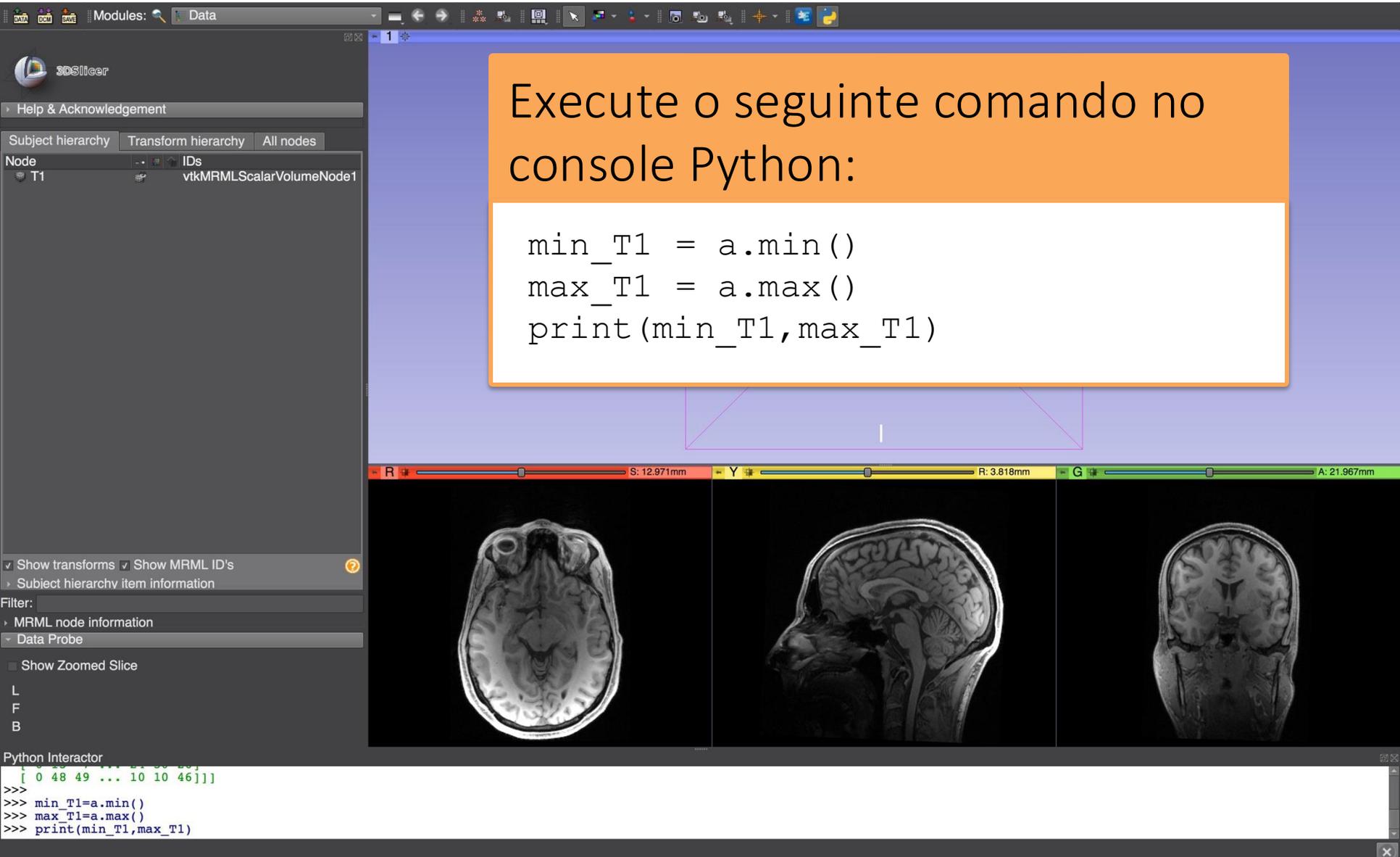
[[[ 0  0  0 ...  0  0  0]
 [ 0  5 41 ... 11  9 48]
 [ 0 21 64 ... 32 11  9]
 ...
 [ 0 11 33 ... 30 11 43]
 [ 0 13  7 ... 24 30 26]
 [ 0 48 49 ... 10 10 46]]]
>>>
```

On the right, a 3D volume rendering of a brain slice is shown. A purple bounding box is drawn around a portion of the volume, with the letter 'S' at the top and 'R' on the left side. A green text box is overlaid on the 3D view, containing the following text:

O Slicer exibe os valores de intensidade da imagem T1.

O Python interactor mostra uma exibição truncada de um array 3D.

Acessando vóxeis em um volume



The image shows a screenshot of the 3D Slicer software interface. The main window displays three orthogonal MRI slices of a brain: an axial slice (left), a sagittal slice (middle), and a coronal slice (right). Above the slices are sliders for slice position: S: 12.971mm, R: 3.818mm, and A: 21.967mm. A large orange box in the center of the main window contains the text: "Execute o seguinte comando no console Python:". Below this box, a white box contains the following Python code:

```
min_T1 = a.min()
max_T1 = a.max()
print(min_T1,max_T1)
```

The left sidebar shows the "Subject hierarchy" with a node "T1" of type "vtkMRMLScalarVolumeNode1". The bottom of the interface features a "Python Interactor" console with the following text:

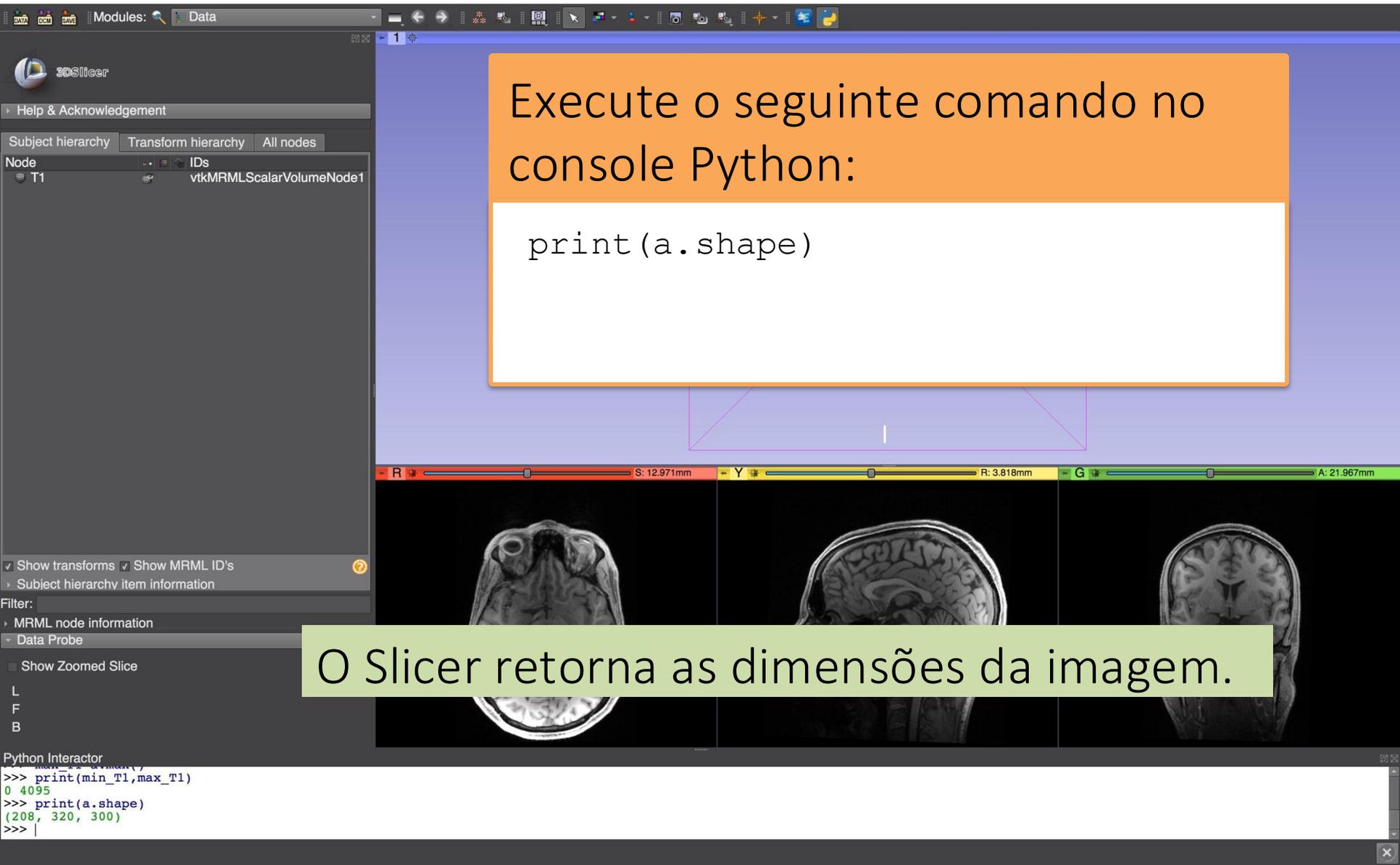
```
[ 0 48 49 ... 10 10 46]]]
>>>
>>> min_T1=a.min()
>>> max_T1=a.max()
>>> print(min_T1,max_T1)
```

Acessando vóxeis em um volume

The screenshot displays the 3D Slicer software interface. The main window shows a T1 MRI volume with a purple bounding box. The bounding box is labeled with 'S' at the top, 'I' at the bottom, 'R' on the left, and 'L' on the right. Below the main window, there are three orthogonal slices: an axial slice on the left, a sagittal slice in the middle, and a coronal slice on the right. The interface includes a toolbar at the top, a sidebar on the left with 'Subject hierarchy', 'Transform hierarchy', and 'All nodes' tabs, and a 'Python Interactor' at the bottom. A text box is overlaid on the image, stating: 'O Slicer retorna os valores mín. e máx. da imagem T1.'

```
>>> min_T1=a.min()
>>> max_T1=a.max()
>>> print(min_T1,max_T1)
0 4095
>>>
```

Modificando vóxeis em um volume



The screenshot displays the 3D Slicer software interface. On the left, the 'Subject hierarchy' panel shows a tree structure with 'T1' and 'vtkMRMLScalarVolumeNode1'. Below it, the 'Python Interactor' console shows the following code and output:

```
>>> print(min_T1,max_T1)
0 4095
>>> print(a.shape)
(208, 320, 300)
>>>
```

In the center, an orange box contains the instruction: 'Execute o seguinte comando no console Python:' followed by a white box with the code `print(a.shape)`. Below this, a purple box highlights a region on the MRI slices. At the bottom, a green box contains the text: 'O Slicer retorna as dimensões da imagem.'

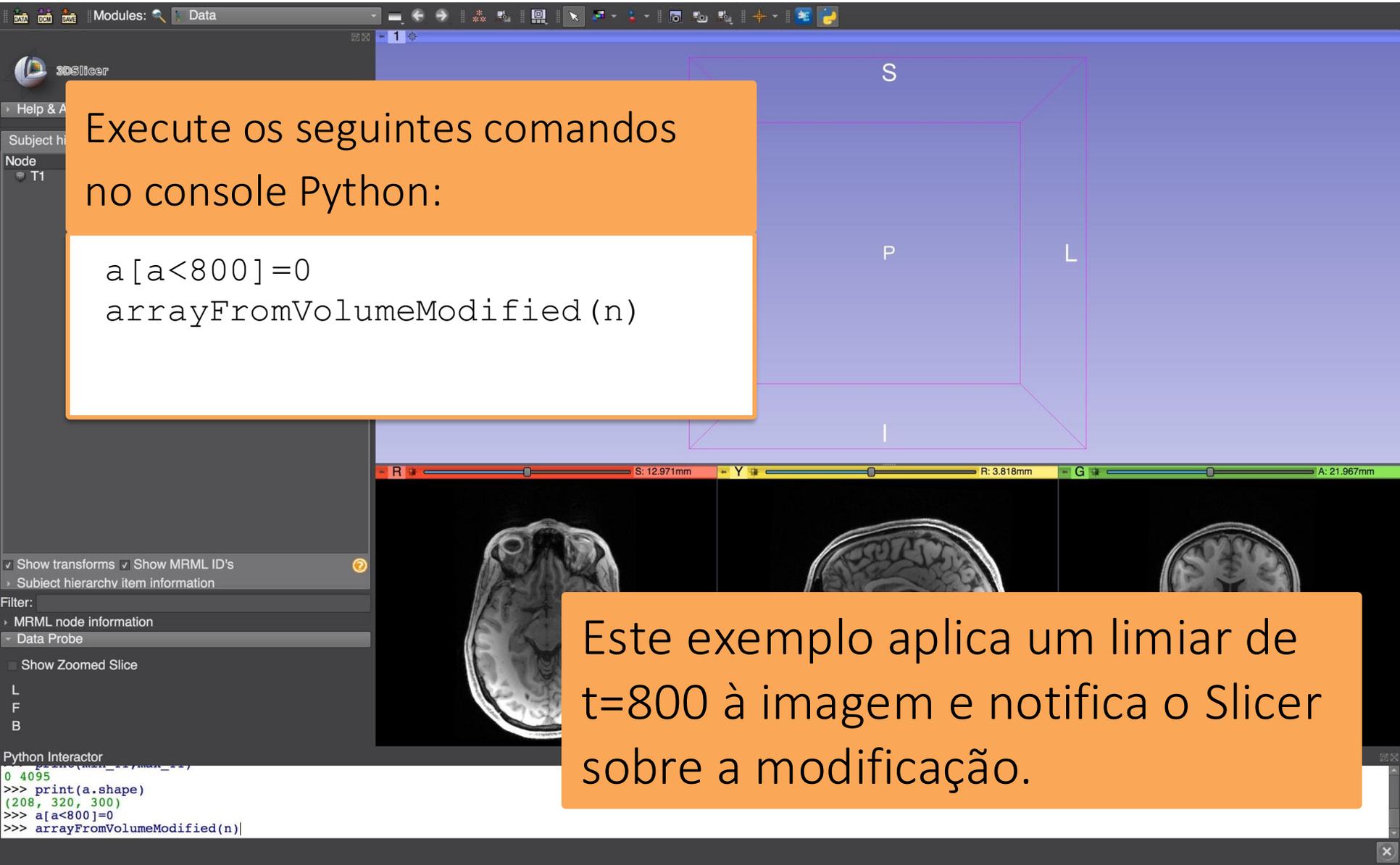
The main window shows three orthogonal MRI slices (axial, sagittal, and coronal) with a toolbar at the top and a status bar at the bottom indicating slice positions: S: 12.971mm, R: 3.818mm, A: 21.967mm.

Modificando vóxeis em um volume

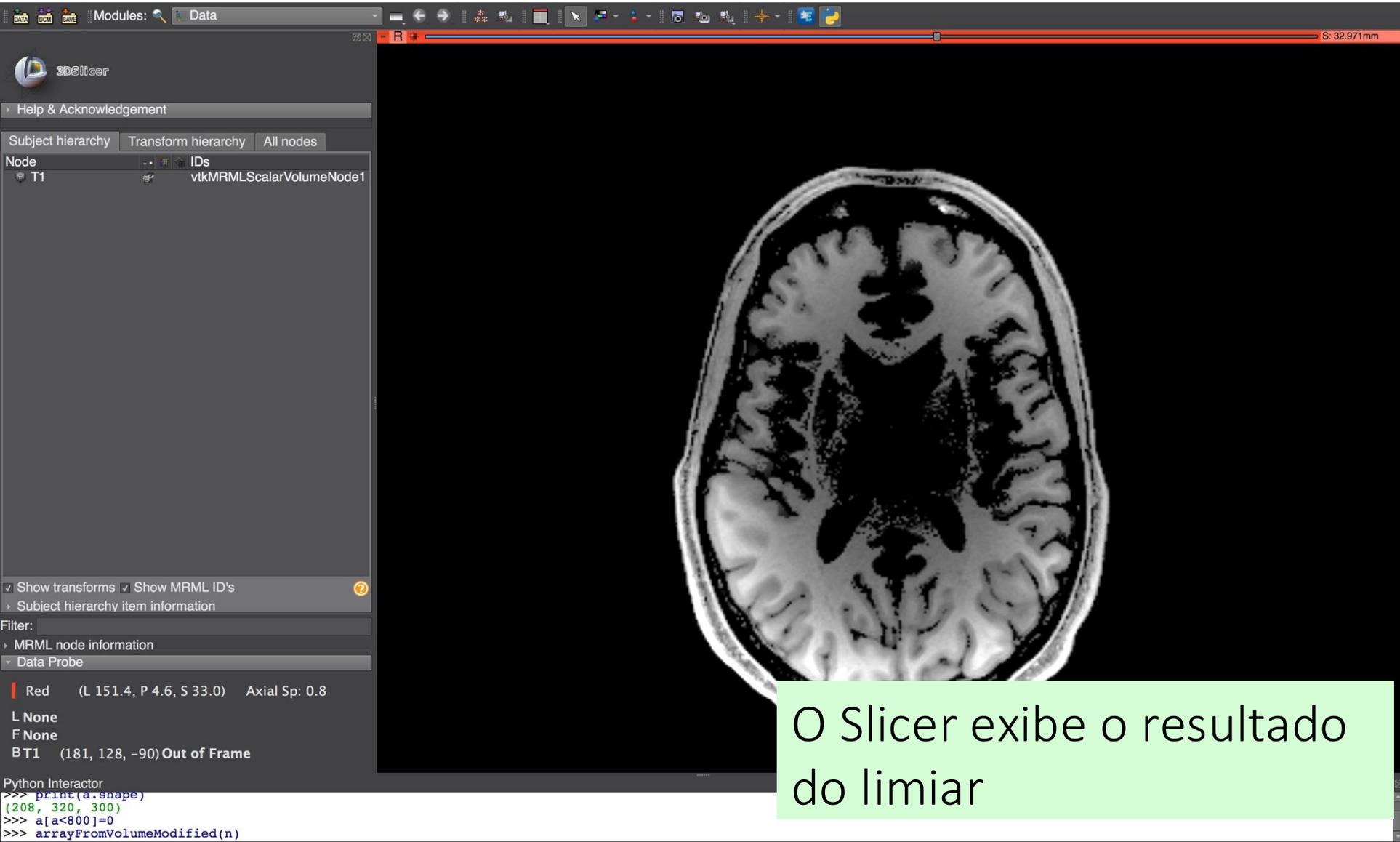
Execute os seguintes comandos no console Python:

```
a[a<800]=0  
arrayFromVolumeModified(n)
```

Este exemplo aplica um limiar de $t=800$ à imagem e notifica o Slicer sobre a modificação.



Modificando vóxeis em um volume



The screenshot displays the 3D Slicer software interface. The main window shows an axial MRI slice of a brain with a threshold filter applied, resulting in a binary image where the brain tissue is white and the background is black. The left sidebar contains a 'Node' list with 'T1' selected, and a 'Data Probe' section showing the current slice coordinates: 'Red (L 151.4, P 4.6, S 33.0) Axial Sp: 0.8'. At the bottom, the Python Interactor shows the following code and output:

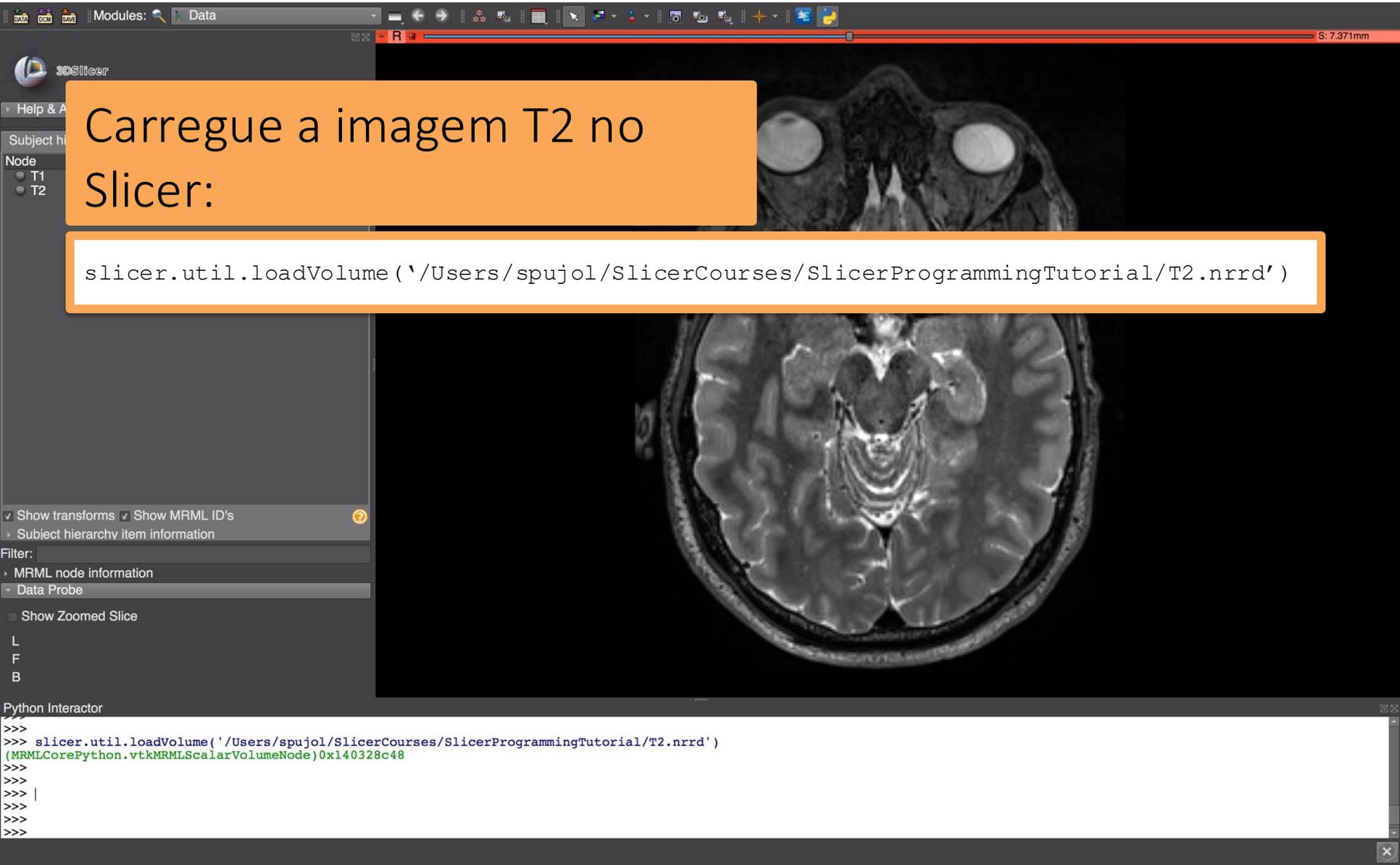
```
>>> print(a.shape)
(208, 320, 300)
>>> a[a<800]=0
>>> arrayFromVolumeModified(n)
```

O Slicer exibe o resultado do limiar

Carregando o volume T2

Carregue a imagem T2 no Slicer:

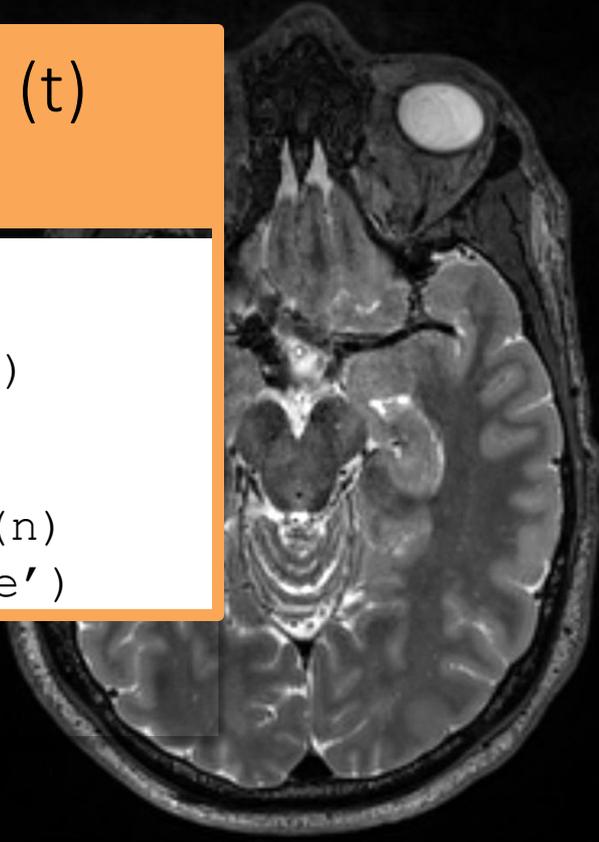
```
slicer.util.loadVolume('/Users/spujol/SlicerCourses/SlicerProgrammingTutorial/T2.nrrd')
```



Função Python: threshold [limiar]

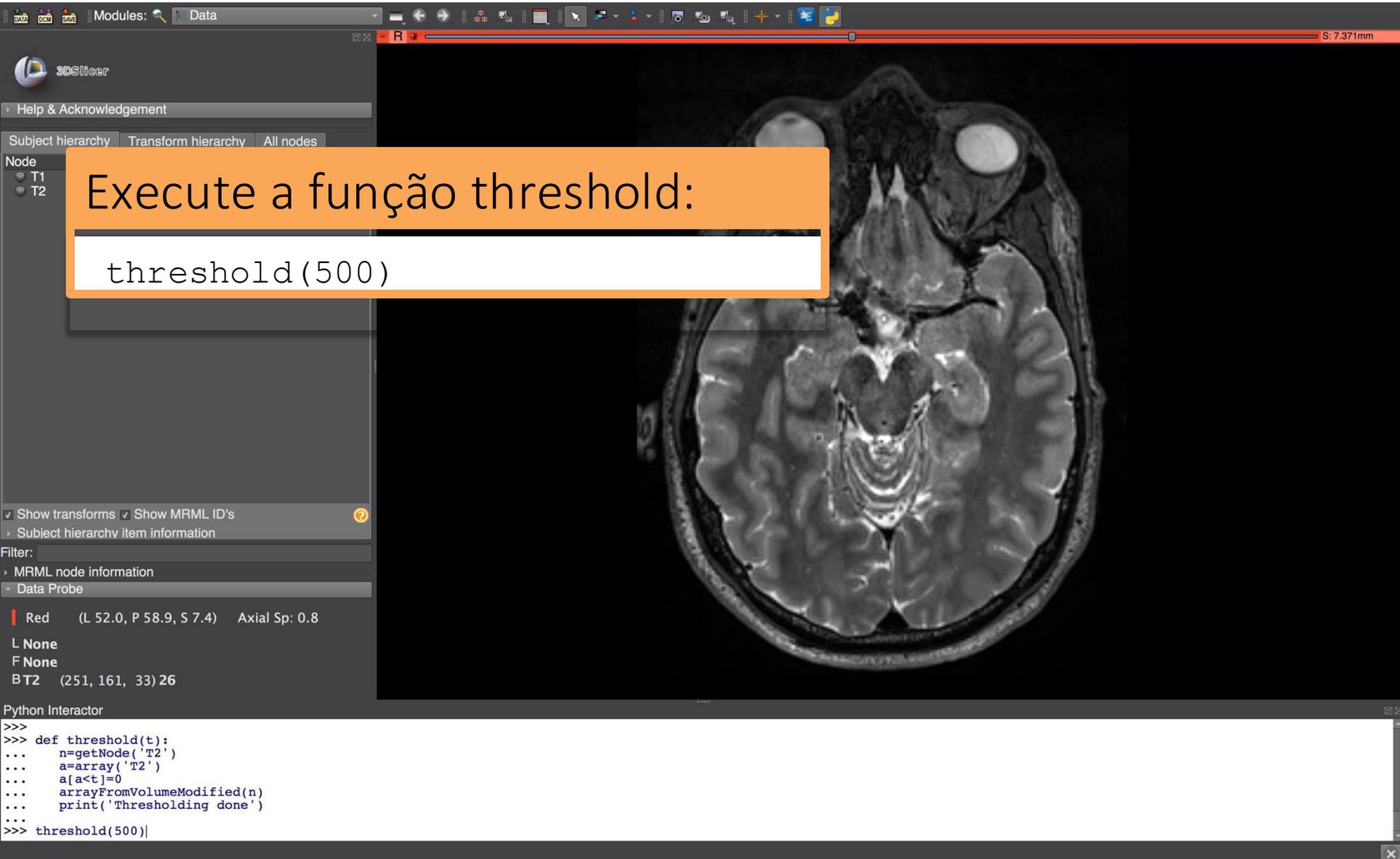
Crie uma função threshold (t)
no Python interactor:

```
def threshold(t):  
n=getNode('T2') a=array('T2')  
a[a<t]=0  
arrayFromVolumeModified(n)  
print('Thresholding done')
```



```
Python Interactor  
>>>  
>>>  
>>> def threshold(t):  
... n=getNode('T2')  
... a=array('T2')  
... a[a<t]=0  
... arrayFromVolumeModified(n)  
... print('Thresholding done')  
...  
...
```

Função Python: threshold

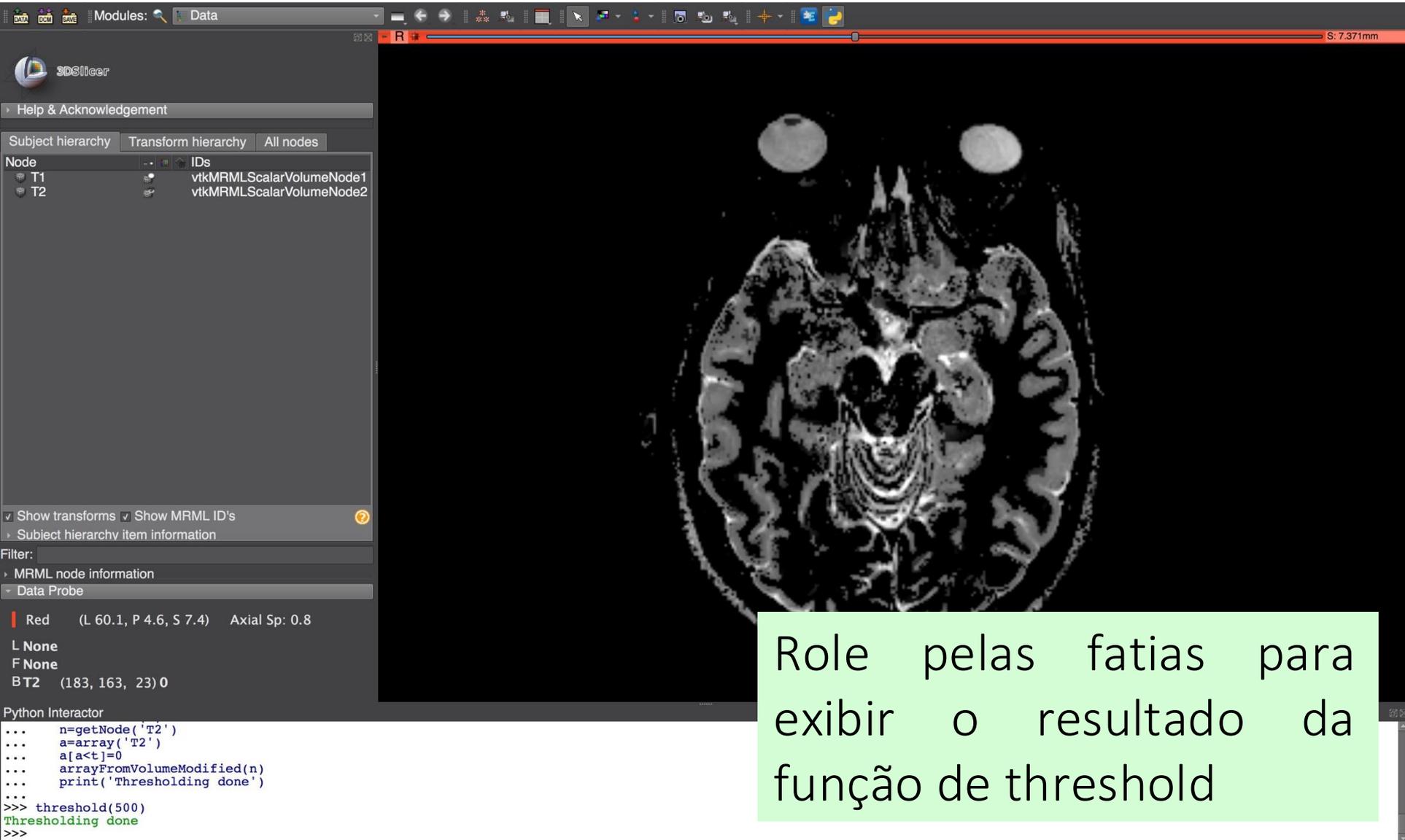


The image shows a screenshot of the 3DSlicer software interface. The main window displays an axial MRI scan of a brain. Overlaid on the left side of the scan is an orange text box containing the instruction "Execute a função threshold:" and a white code block containing the Python function call `threshold(500)`. The software interface includes a top toolbar, a left sidebar with a "Node" list showing "T1" and "T2", and a bottom "Python Interactor" window. The Python Interactor window shows the following code:

```
>>>
>>> def threshold(t):
...     n=getNode('T2')
...     a=array('T2')
...     a[a<t]=0
...     arrayFromVolumeModified(n)
...     print('Thresholding done')
...
>>> threshold(500)
```

The Python Interactor window also shows the output of the function call, which is not visible in the screenshot.

Função Python: threshold



The screenshot displays the 3D Slicer software interface. The main window shows an axial MRI slice of a brain. The left sidebar contains a 'Node' list with 'T1' and 'T2' entries. Below the sidebar, there are checkboxes for 'Show transforms' and 'Show MRML ID's', and a 'Filter:' section with 'MRML node information' and 'Data Probe' options. The bottom of the interface features a 'Python Interactor' with the following code:

```
>>> n=getNode('T2')
>>> a=array('T2')
>>> a[a<t]=0
>>> arrayFromVolumeModified(n)
>>> print('Thresholding done')
>>>
>>> threshold(500)
Thresholding done
>>>
```

A green text box in the bottom right corner of the image contains the text: "Role pelas fatias para exibir o resultado da função de threshold".

Visão Geral

- O Slicer oferece fácil acesso para analisar e modificar tipos de dados complexos.
- O Slicer é compatível com uma ampla gama de pacotes de computação científica em Python.
- O Slicer é um ambiente de pesquisa para realizar experimentos de imagens médicas.

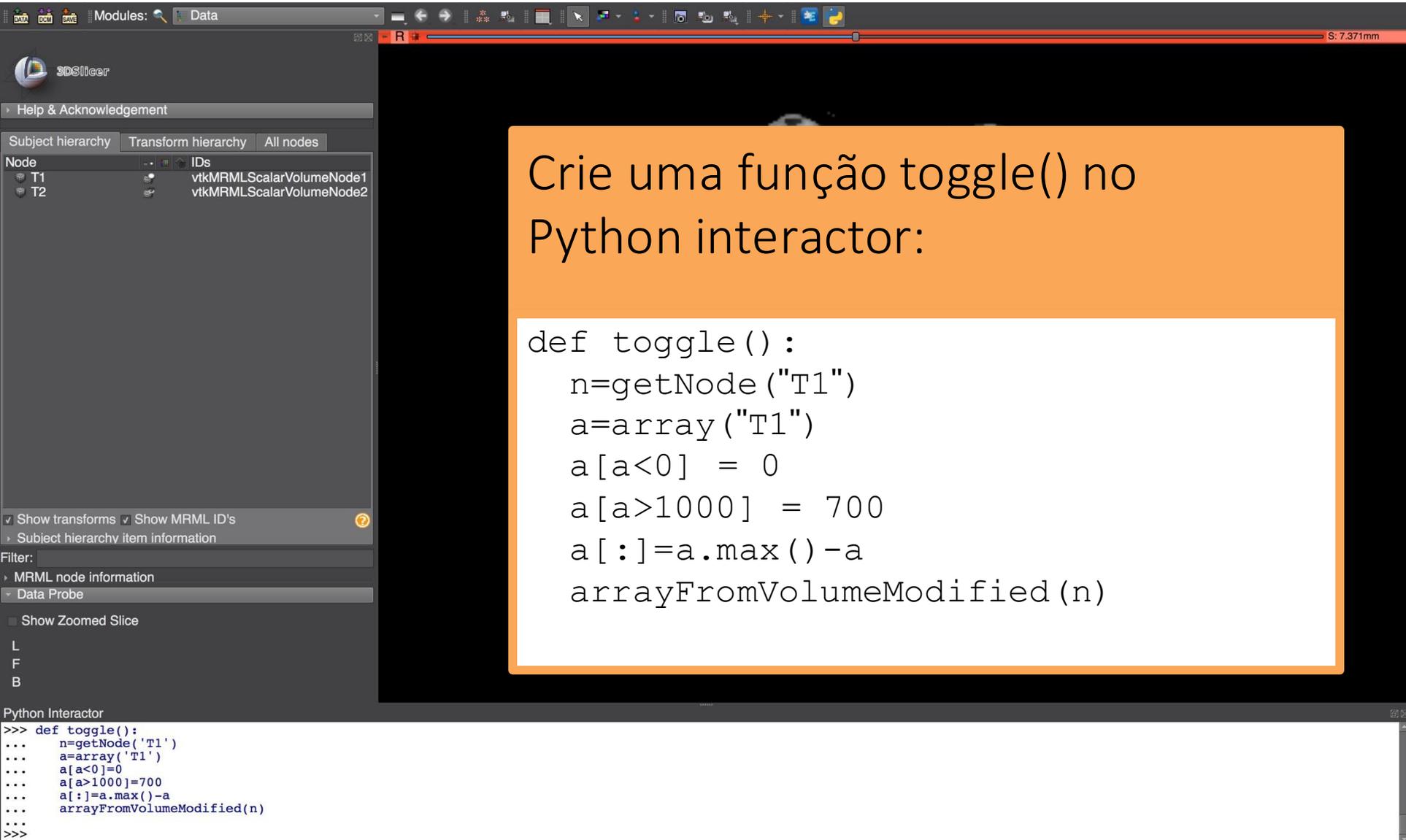
Parte 3

Familiarizando-se com o Qt no Slicer

Qt & PythonQt

- O Qt é a principal ferramenta no Slicer para criar *widgets*, diálogos, campos de texto etc.
- O PythonQt expõe a maioria das funcionalidades do Qt e é acessível por meio do *Python interactor* no Slicer.
- Interfaces de usuário podem ser criadas rapidamente para prototipagem e depuração.

Função Python: toggle [alternar]



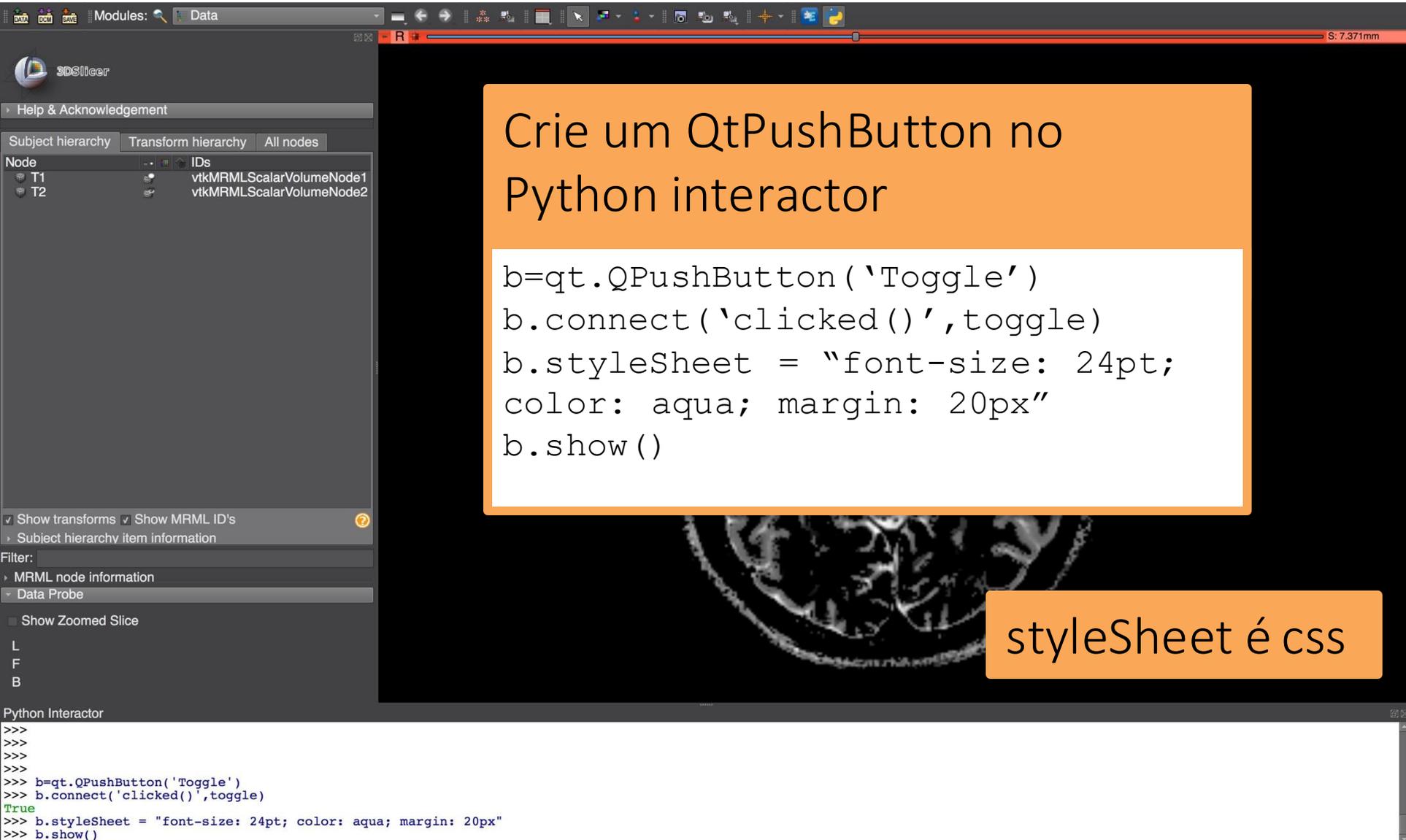
The image shows a screenshot of the 3D Slicer software interface. The main window displays a subject hierarchy with two nodes, T1 and T2, and their corresponding MRML IDs. The Python Interactor window at the bottom shows the following code:

```
>>> def toggle():
...     n=getNode('T1')
...     a=array('T1')
...     a[a<0]=0
...     a[a>1000]=700
...     a[:]=a.max()-a
...     arrayFromVolumeModified(n)
...
>>>
```

The code defines a function named `toggle()` that performs the following operations:

- Retrieves the node `T1` using `getNode('T1')`.
- Creates an array `a` from the volume `T1` using `array('T1')`.
- Clips the array `a` to the range $[0, 700]$ using `a[a < 0] = 0` and `a[a > 1000] = 700`.
- Inverts the array `a` using `a[:] = a.max() - a`.
- Triggers a volume update using `arrayFromVolumeModified(n)`.

Criando um Botão de *Push* do Qt

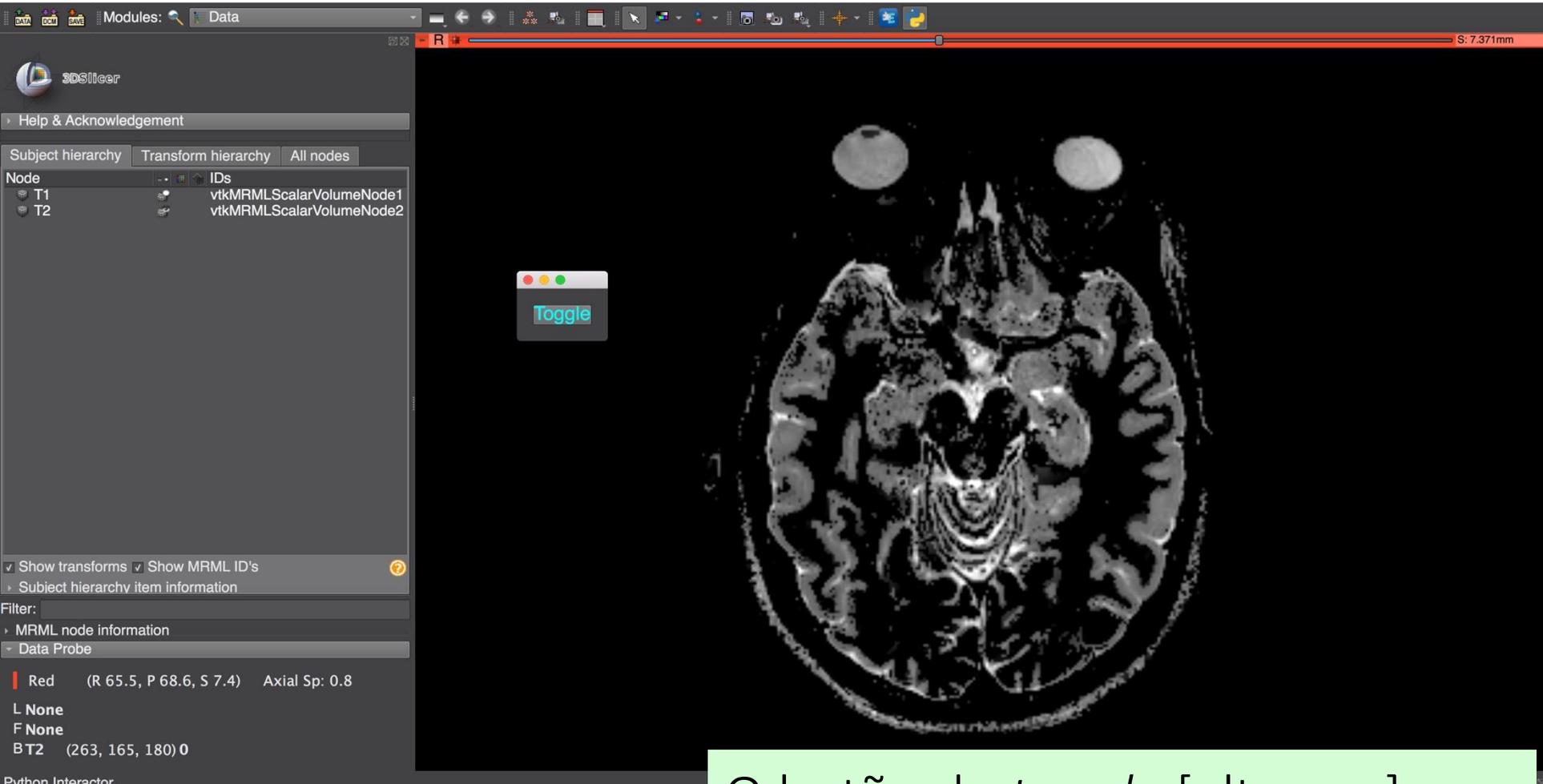


The screenshot shows the 3D Slicer software interface. On the left, there are panels for 'Subject hierarchy', 'Transform hierarchy', and 'All nodes'. The 'Subject hierarchy' panel shows two nodes: 'T1' and 'T2', both of type 'vtkMRMLScalarVolumeNode'. Below this, there are checkboxes for 'Show transforms', 'Show MRML ID's', and 'Subject hierarchy item information'. The 'Filter:' section is currently empty. At the bottom left, there is a 'Python Interactor' window with the following code:

```
>>>
>>>
>>>
>>> b=qt.QPushButton('Toggle')
>>> b.connect('clicked()',toggle)
True
>>> b.styleSheet = "font-size: 24pt; color: aqua; margin: 20px"
>>> b.show()
```

In the center of the main window, there is a large orange box with the text: "Crie um QPushButton no Python interactor". Below this, a white box contains the same code as shown in the Python Interactor window. At the bottom right, another orange box contains the text: "styleSheet é css". The background of the main window shows a grayscale MRI scan of a brain slice.

Criando um Botão de *Push* do Qt

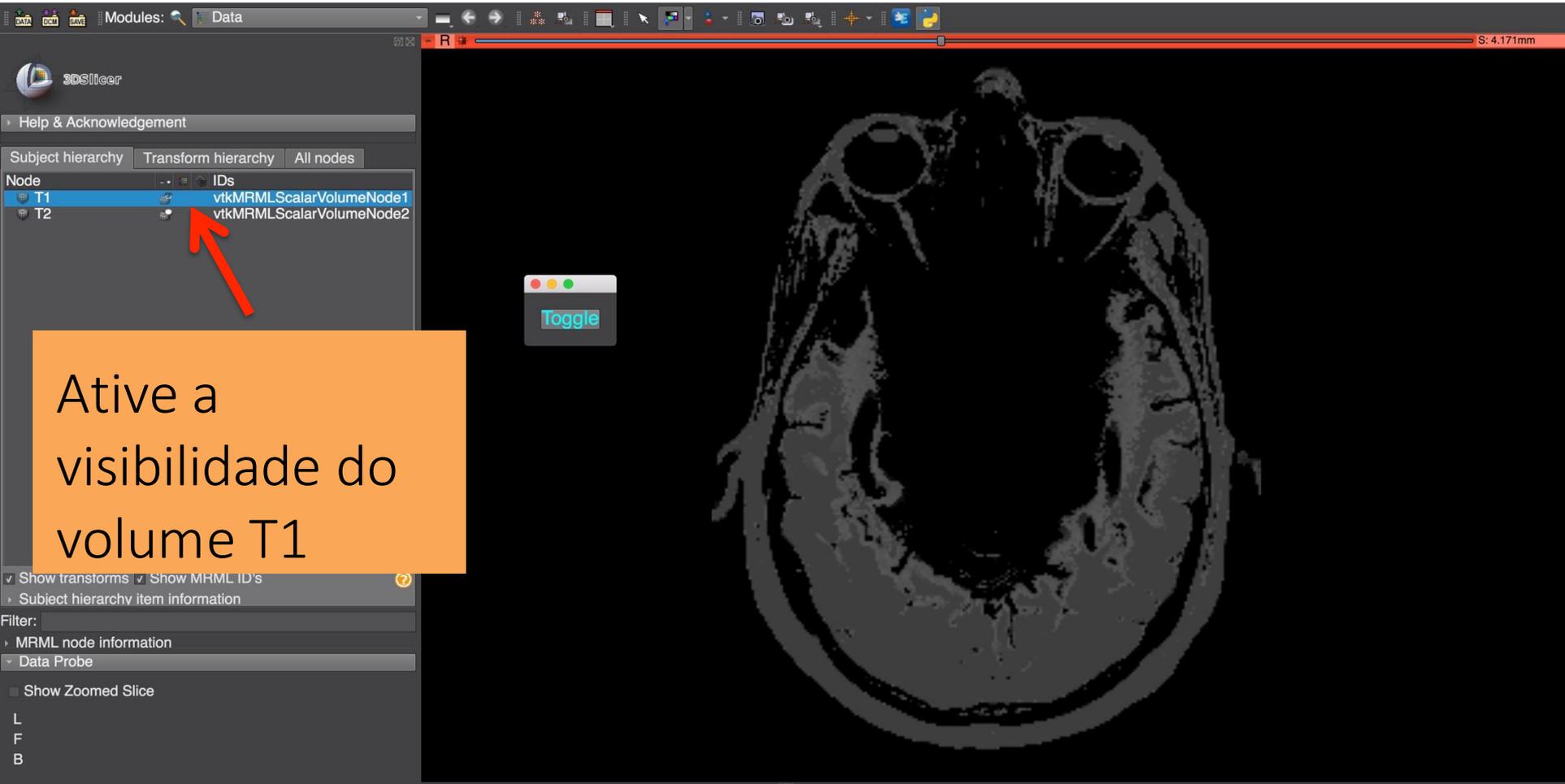


The screenshot displays the 3D Slicer application window. The main view shows an axial MRI slice of a brain. A small Qt window titled "Toggle" is positioned over the scan. The left sidebar contains a "Subject hierarchy" panel with nodes "T1" and "T2". Below it is a "Data Probe" section showing parameters like "Red (R 65.5, P 68.6, S 7.4) Axial Sp: 0.8". At the bottom, a "Python Interactor" shows the following code:

```
>>>
>>>
>>>
>>> b=qt.QPushButton('Toggle')
>>> b.connect('clicked()',toggle)
True
>>> b.setStyleSheet = "font-size: 24pt; color: aqua; margin: 20px"
>>> b.show()
>>>
```

O botão de *toggle* [alternar] aparece

Criando um Botão de *Push* do Qt



The screenshot shows the 3D Slicer interface. On the left, the 'Subject hierarchy' panel is visible, showing a tree structure with nodes 'T1' and 'T2'. A red arrow points to the 'T1' node, which is highlighted in blue. The 'T1' node is associated with the ID 'vtkMRMLScalarVolumeNode1'. Below the hierarchy, there are checkboxes for 'Show transforms', 'Show MRML ID's', and 'Subject hierarchy item information'. At the bottom left, there is a 'Python Interactor' window with the following code:

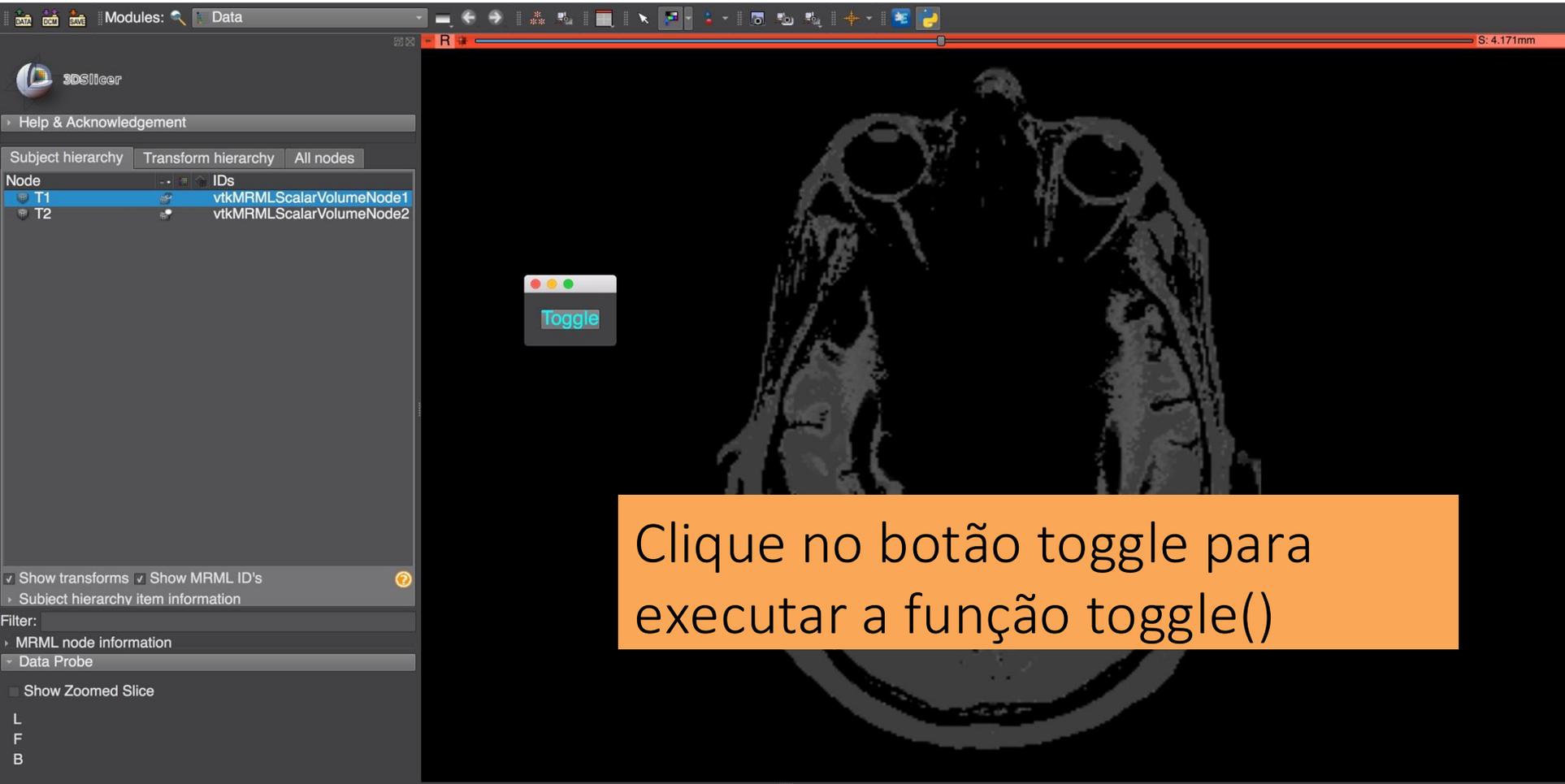
```
>>>
>>>
>>>
>>> b=qt.QPushButton('Toggle')
>>> b.connect('clicked()',toggle)
True
>>> b.setStyleSheet = "font-size: 24pt; color: aqua; margin: 20px"
>>> b.show()
>>>
```

In the center of the main 3D view, a small window with a 'Toggle' button is displayed. The button is a light blue rectangle with the word 'Toggle' in white text. The background of the 3D view is a grayscale MRI scan of a human head, showing the brain and surrounding structures.

At the bottom left, there is an orange text box with the following text:

Ative a visibilidade do volume T1

Criando um Botão de *Push* do Qt

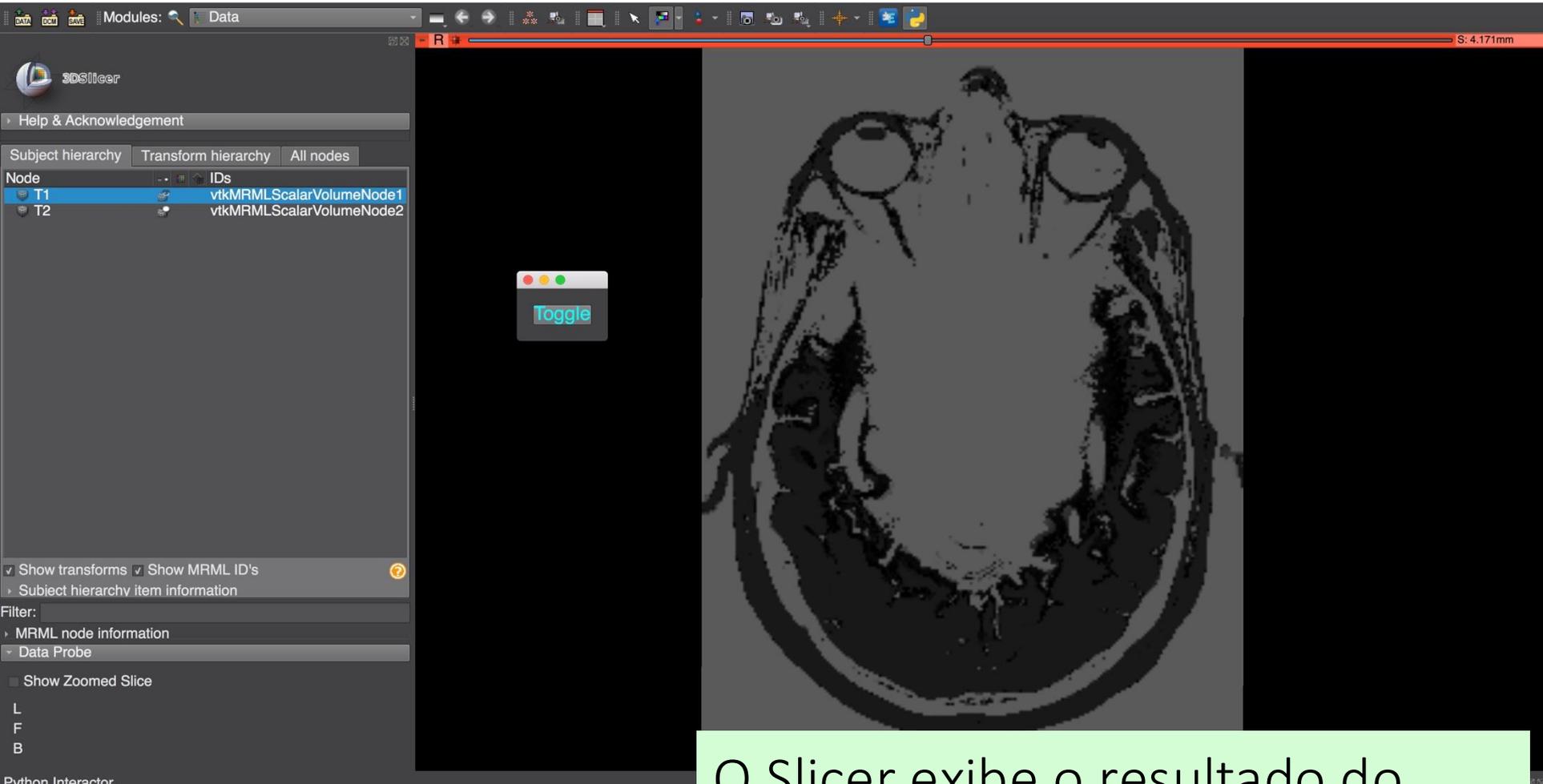


The screenshot shows the 3D Slicer application interface. On the left, there is a sidebar with a subject hierarchy showing nodes T1 and T2. The main 3D view area displays an axial MRI slice of a brain. A small window with a 'Toggle' button is overlaid on the 3D view. At the bottom, a Python Interactor shows the following code:

```
>>>  
>>>  
>>> b=qt.QPushButton('Toggle')  
>>> b.connect('clicked()',toggle)  
True  
>>> b.setStyleSheet = "font-size: 24pt; color: aqua; margin: 20px"  
>>> b.show()  
>>>
```

Clique no botão toggle para executar a função toggle()

Criando um Botão de *Push* do Qt



The screenshot shows the Slicer software interface. On the left, there is a sidebar with a 'Subject hierarchy' panel containing nodes 'T1' and 'T2'. Below it is a 'Python Interactor' panel with the following code:

```
>>>
>>>
>>>
>>> b=qt.QPushButton('Toggle')
>>> b.connect('clicked()',toggle)
True
>>> b.setStyleSheet = "font-size: 24pt; color: aqua; margin: 20px"
>>> b.show()
>>>
```

In the center of the main window, a small Qt window titled 'Toggle' is displayed, featuring a blue button with the text 'Toggle'. The main window displays a grayscale axial MRI slice of a brain. The top status bar indicates 'S: 4.171mm'.

O Slicer exibe o resultado do processamento de imagem.

Exemplos de módulos com *scripts*

- O tutorial demonstra como criar uma interface simples em Python.
- O Slicer integra muitos módulos com *scripts* sofisticados, como Segment Statistics, Sample Data, módulo de Endoscopia etc.
- Para mais informações, consulte o Repositório de Scripts do Slicer:
<https://www.slicer.org/wiki/Documentation/Nightly/ScriptRepository>

Conclusão

- O Slicer permite que os desenvolvedores criem interfaces complexas que são otimizadas para os usuários-alvo.
- A plataforma de software oferece possibilidades ilimitadas de personalização.
- O Slicer dá acesso a bibliotecas avançadas subjacentes por meio de um pacote multiplataforma que é fácil de implementar para os usuários finais.

Agradecimentos

NAC

Neuroimage Analysis Center

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