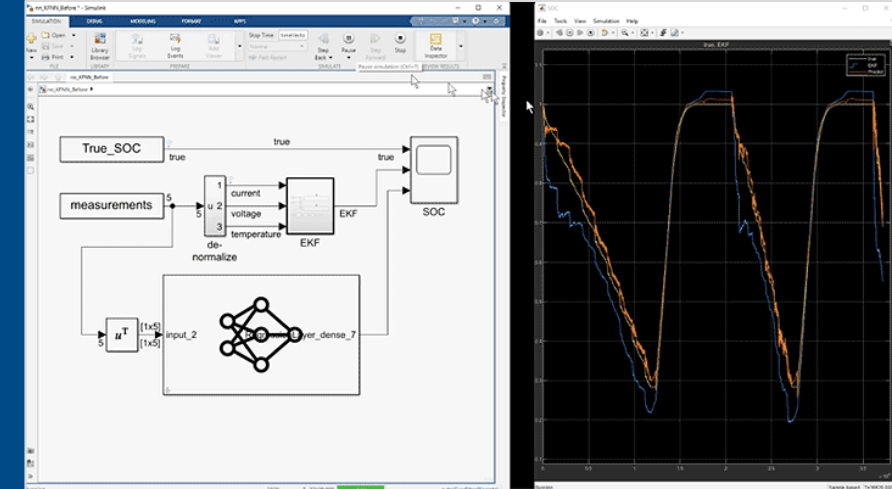
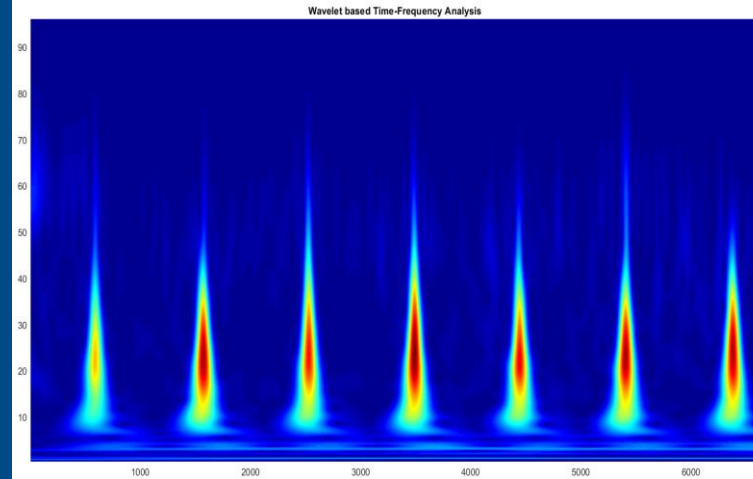
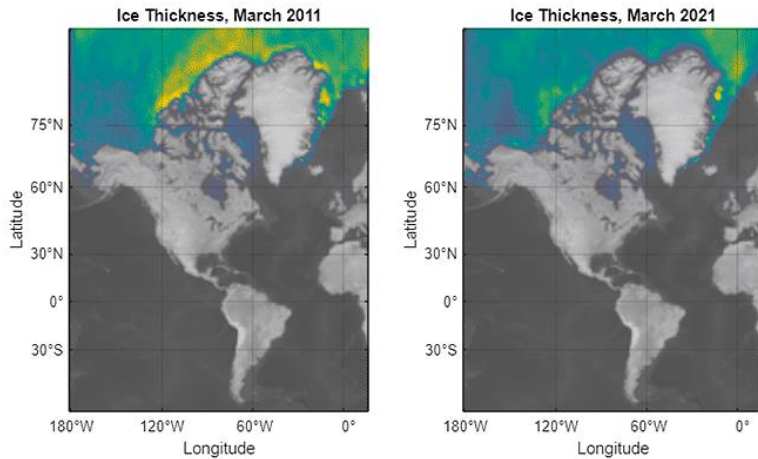




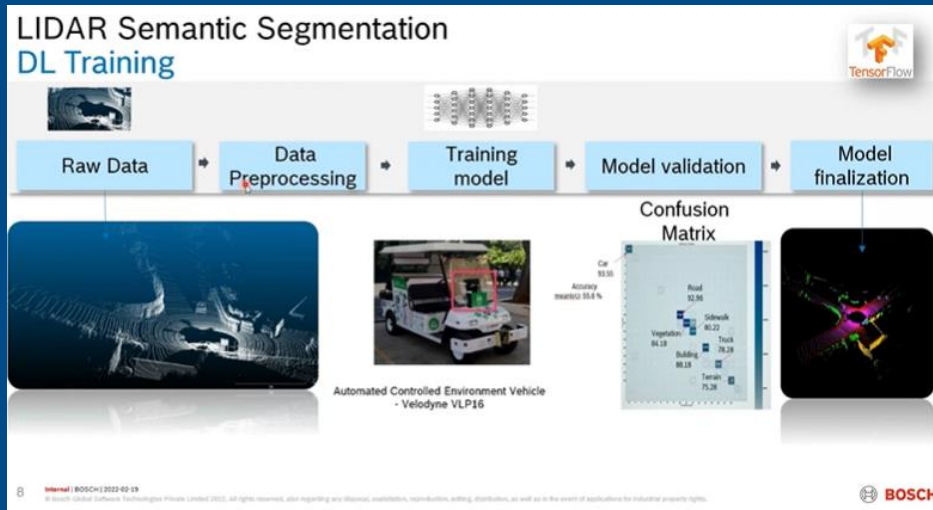
MATLAB with Python

Why use MATLAB and Python together?



1. Reuse existing code
2. Use functionality from other language
3. Collaborate

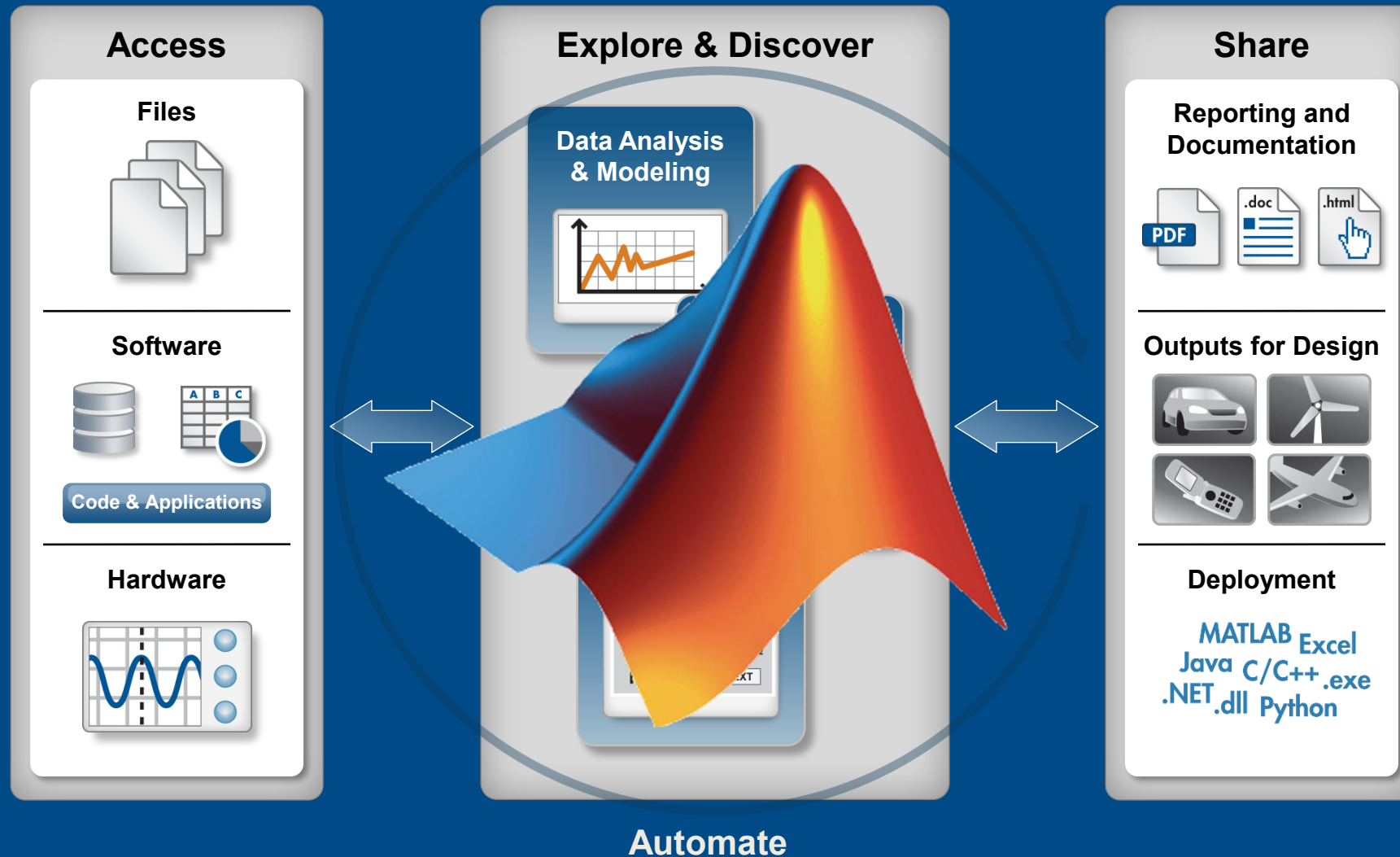
Examples of interoperability in Industry



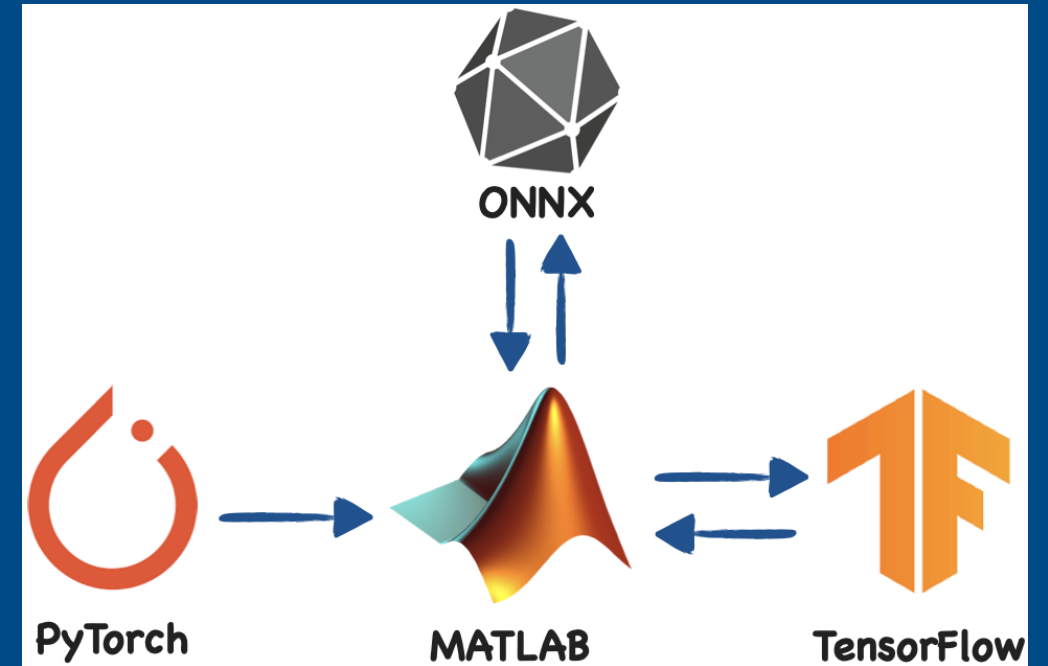
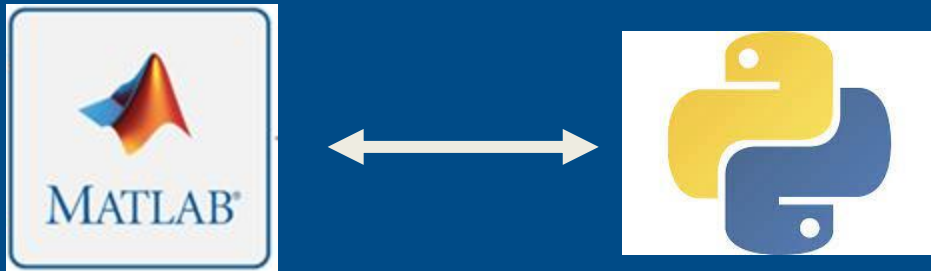
Bosch Designs and Implements a Lidar Point Cloud Classifier with MATLAB and Deep Learning Toolbox

CODA

Data Analysis Workflow



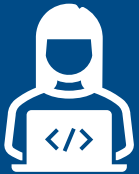
What is interoperability?





I would like to **integrate my colleagues' Python codes** in my MATLAB simulations models, is it possible?

You can call Python code and models directly from MATLAB!



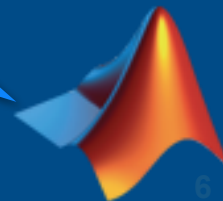
Can I use my colleagues **MATLAB codes and apps** in Python?

Yes! You can import saved MATLAB models, apps and scripts into Python!



Can I build an engineering project using a Python AI algorithm and deploy it to hardware?

Yes! Import the Python model into MATLAB/Simulink and then deploy it to hardware using automated code generation.



Ways to Interoperate

Python
Interface

MATLAB
Engine

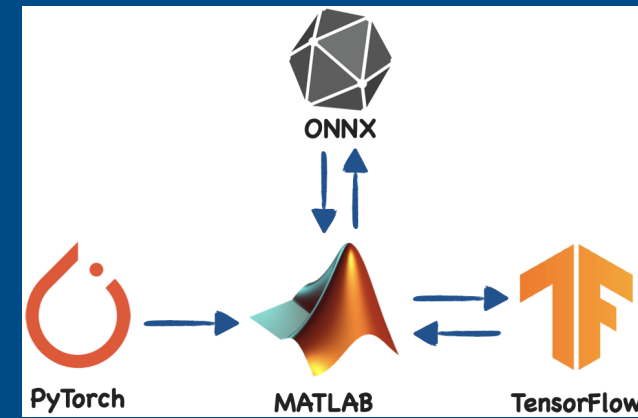
MATLAB-Python
Coexecution

TensorFlow
Converter

ONNX
Converter

PyTorch
Converter

Model Exchange

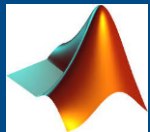


Ways to Interoperate

Python
Interface

MATLAB
Engine

MATLAB-Python
Coexecution

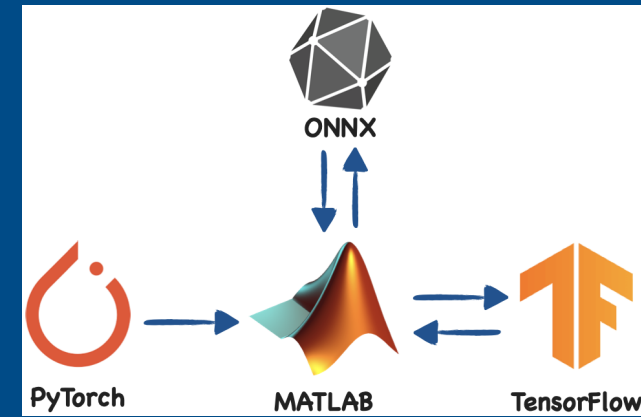


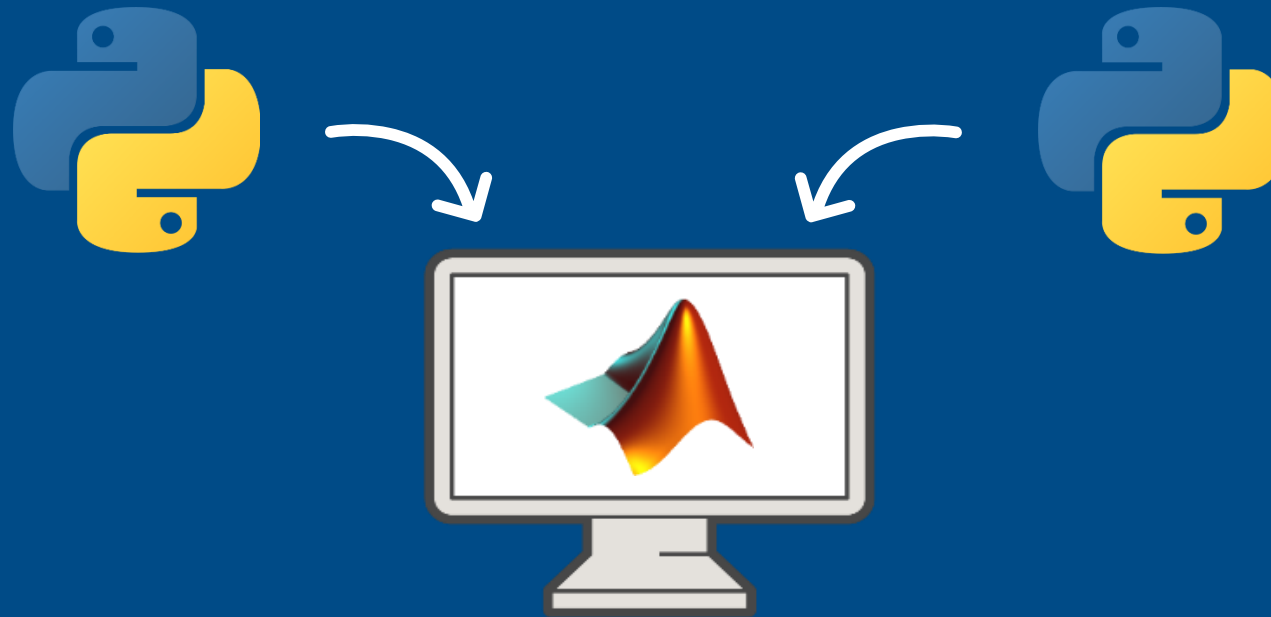
TensorFlow
Converter

ONNX
Converter

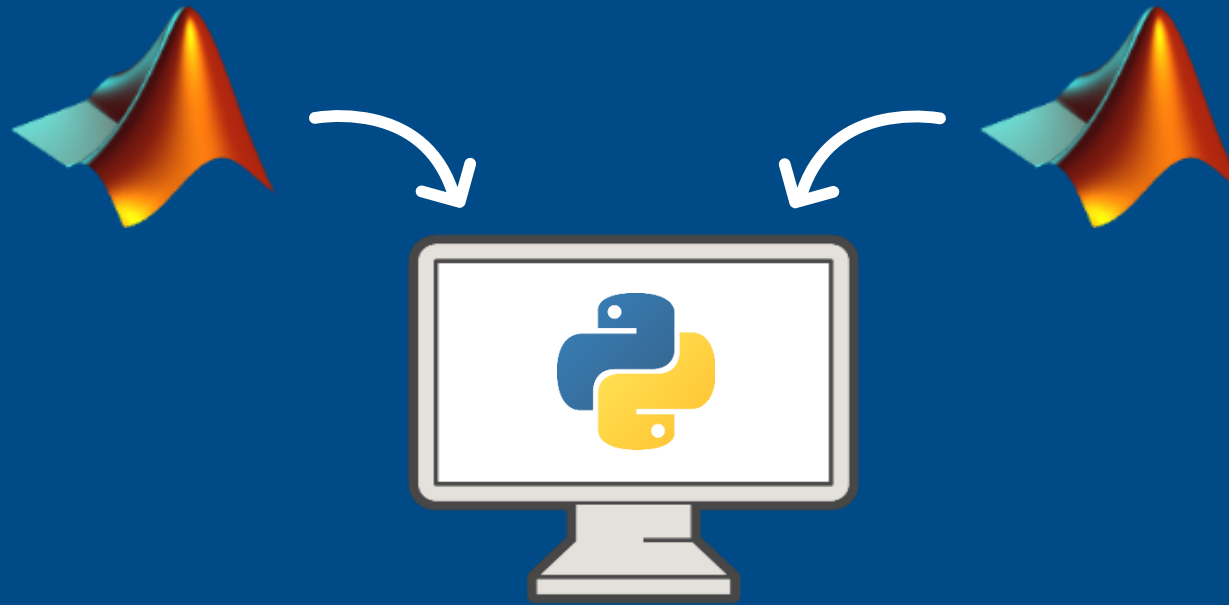
PyTorch
Converter

Model Exchange





Call Python from MATLAB



Call MATLAB from Python

Call MATLAB from Python

MATLAB Engine API



- Install MATLAB Engine API for Python (from PyPI)

```
$ pip install matlabengine
```

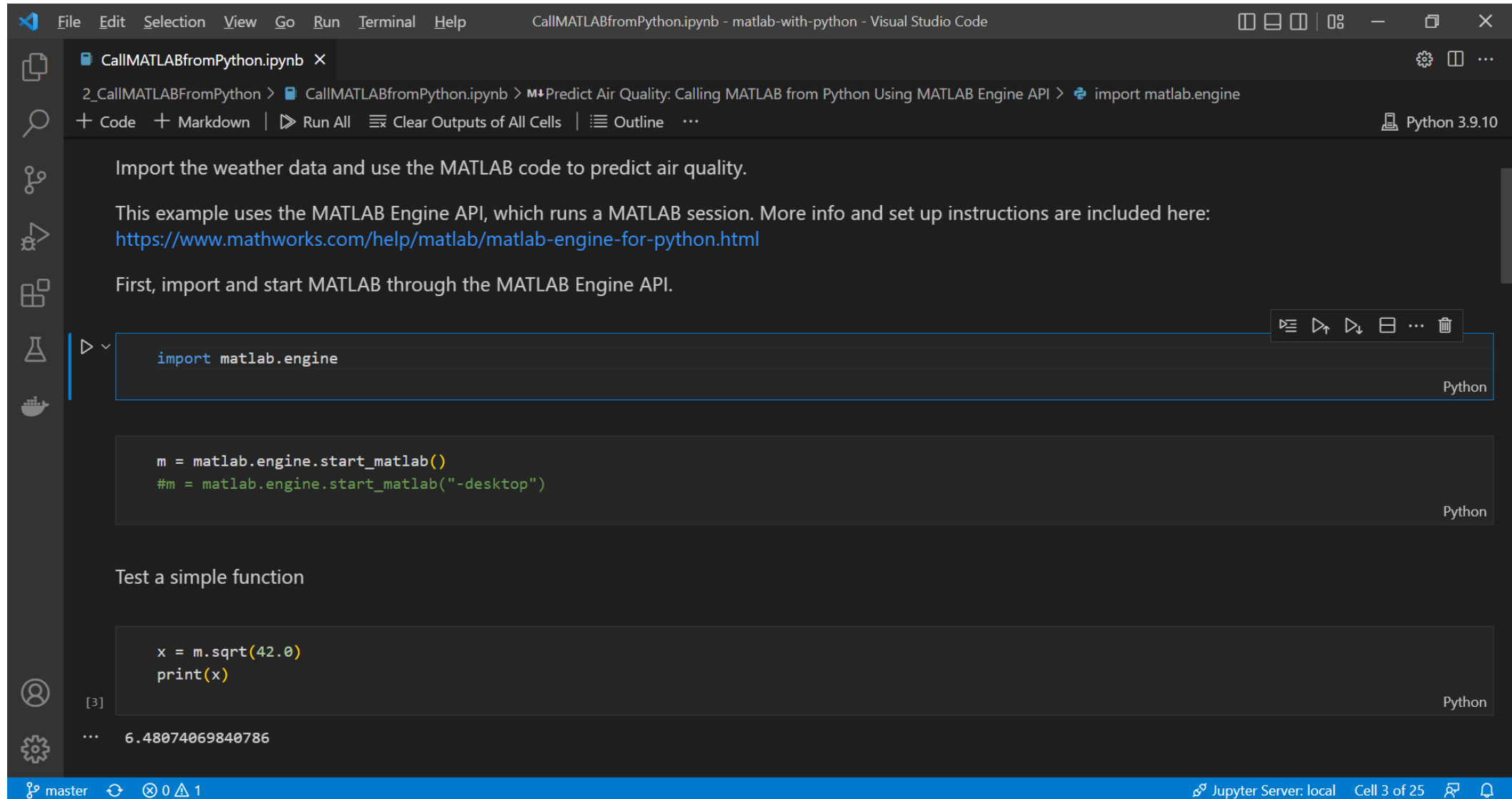
- Start a MATLAB process

```
>>> import matlab.engine
```

```
>>> m = matlab.engine.start_matlab()
```

- Call MATLAB functions

```
>>> x = m.sqrt(42.0)
```



The screenshot shows a Jupyter Notebook titled "CallMATLABfromPython.ipynb" in Visual Studio Code. The notebook is running on a Python 3.9.10 kernel. The content includes instructions on how to use the MATLAB Engine API to predict air quality. The first cell imports the MATLAB engine. The second cell starts the MATLAB engine. The third cell tests a simple function by calculating the square root of 42.0. The output of the third cell is 6.48074069840786.

File Edit Selection View Go Run Terminal Help CallMATLABfromPython.ipynb - matlab-with-python - Visual Studio Code

2_CallMATLABFromPython > CallMATLABfromPython.ipynb > **M**Predict Air Quality: Calling MATLAB from Python Using MATLAB Engine API > import matlab.engine

+ Code + Markdown | ▶ Run All ⌵ Clear Outputs of All Cells | ⌵ Outline ... Python 3.9.10

Import the weather data and use the MATLAB code to predict air quality.

This example uses the MATLAB Engine API, which runs a MATLAB session. More info and set up instructions are included here:
<https://www.mathworks.com/help/matlab/matlab-engine-for-python.html>

First, import and start MATLAB through the MATLAB Engine API.

```
import matlab.engine
```

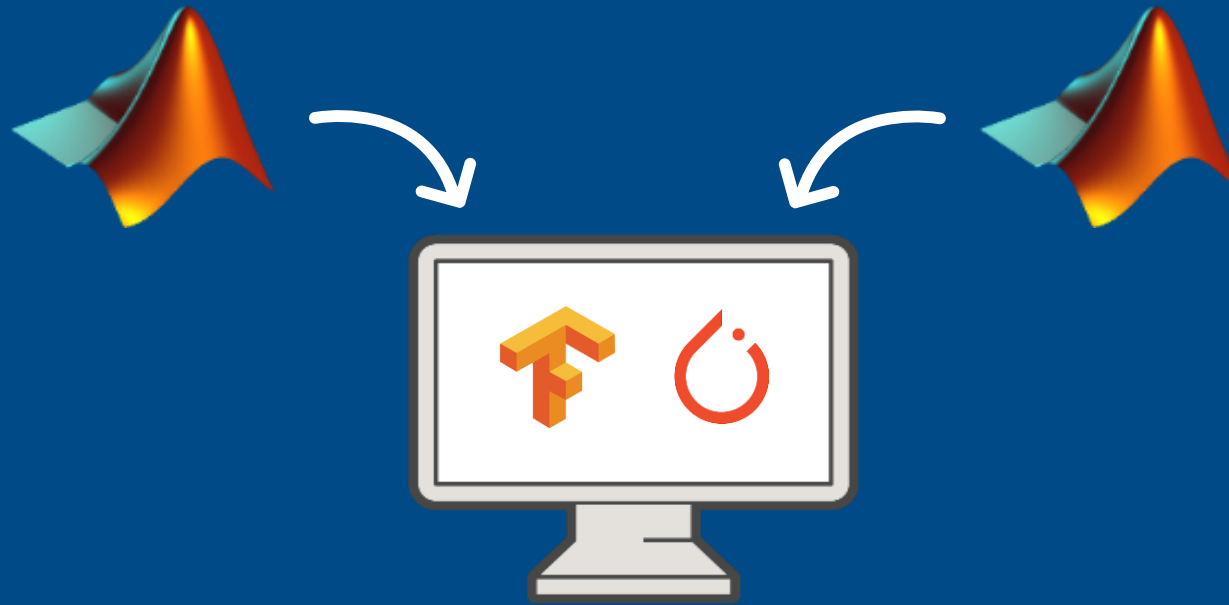
```
m = matlab.engine.start_matlab()  
#m = matlab.engine.start_matlab("-desktop")
```

Test a simple function

```
x = m.sqrt(42.0)  
print(x)
```

[3] ... 6.48074069840786

master 0 1 Jupyter Server: local Cell 3 of 25



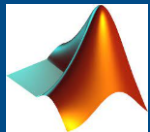
Additional Options

Ways to Interoperate

Python
Interface

MATLAB
Engine

MATLAB-Python
Coexecution

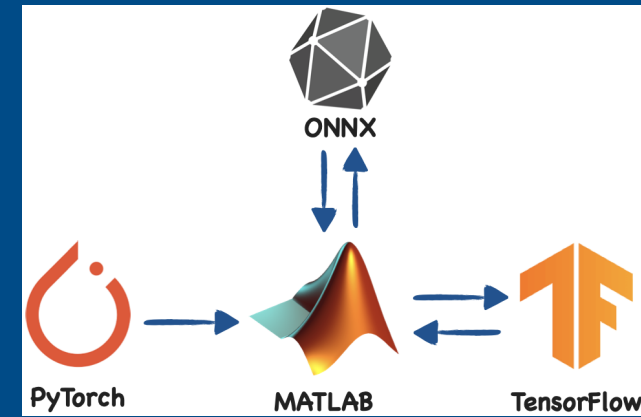


TensorFlow
Converter

ONNX
Converter

PyTorch
Converter

Model Exchange



MATLAB Central Community

Every month, over **2 million** MATLAB & Simulink users visit MATLAB Central to get questions answered, download code and improve programming skills.



MATLAB Answers: Q&A forum; most questions answered in < 1 hour

File Exchange: Download code from a huge repository of free code including **tens of thousands** of open source community files

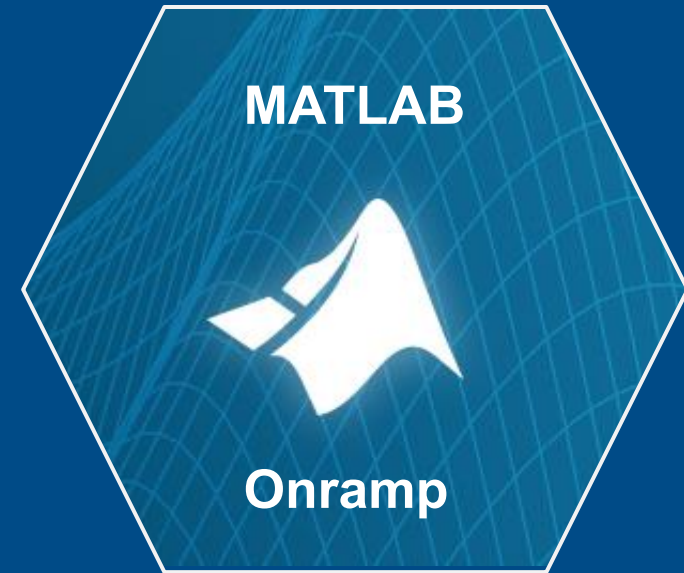
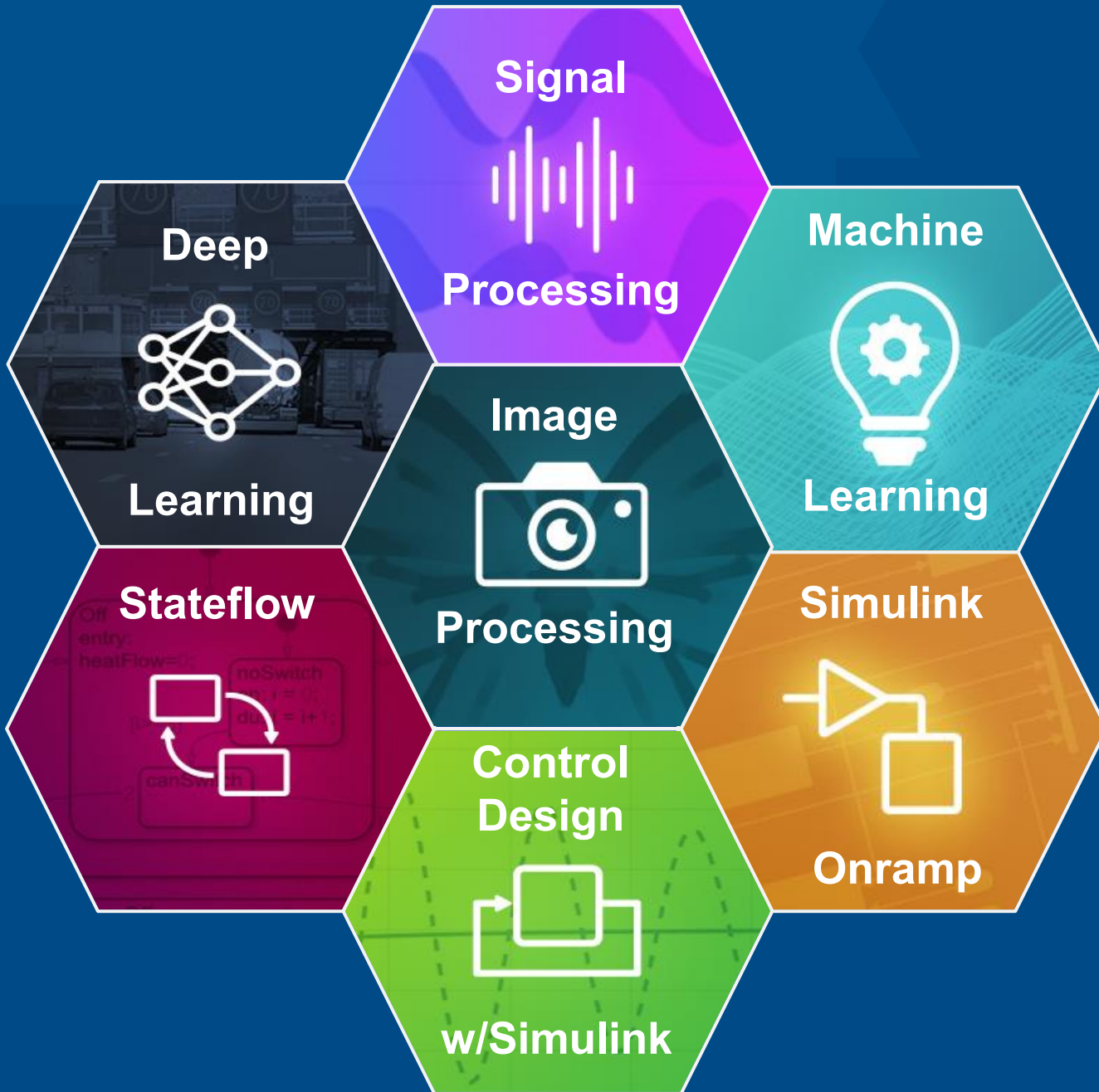
Cody: Sharpen programming skills while having fun

Blogs: Get the inside view from Engineers who build and support MATLAB & Simulink

ThingSpeak: Explore LoT Data

And more for you to explore...

Onramp Courses



MathWorks Engineering Support



Training



Guided Evaluations



Onsite Workshops



Consulting



Technical Support

Support from MathWorks

- Seminar/workshop/training
- MATLAB Community Toolbox support
- Licenses
- Hackathon/event monetary support
- MCT Monetary support
- DCRG Program



Quick
Support

Proposal
Required

Contact Info & Thank You!

Laura Keen – Lkeen@mathworks.com
<https://github.com/drLKeen/NIHmatlabpython>

Elvira Osuna-Highley – eosunahi@mathworks.com

Tim Mathieu – tmathieu@mathworks.com

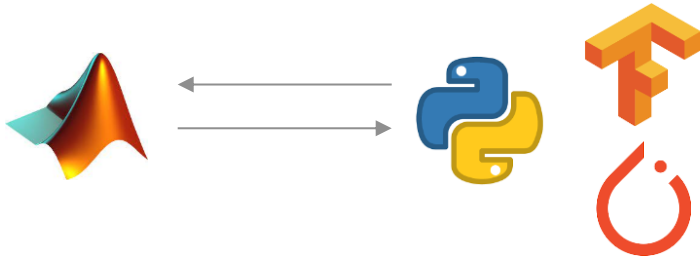
Matt DiGiandomenico – mdigiand@mathworks.com



MATLAB with Python

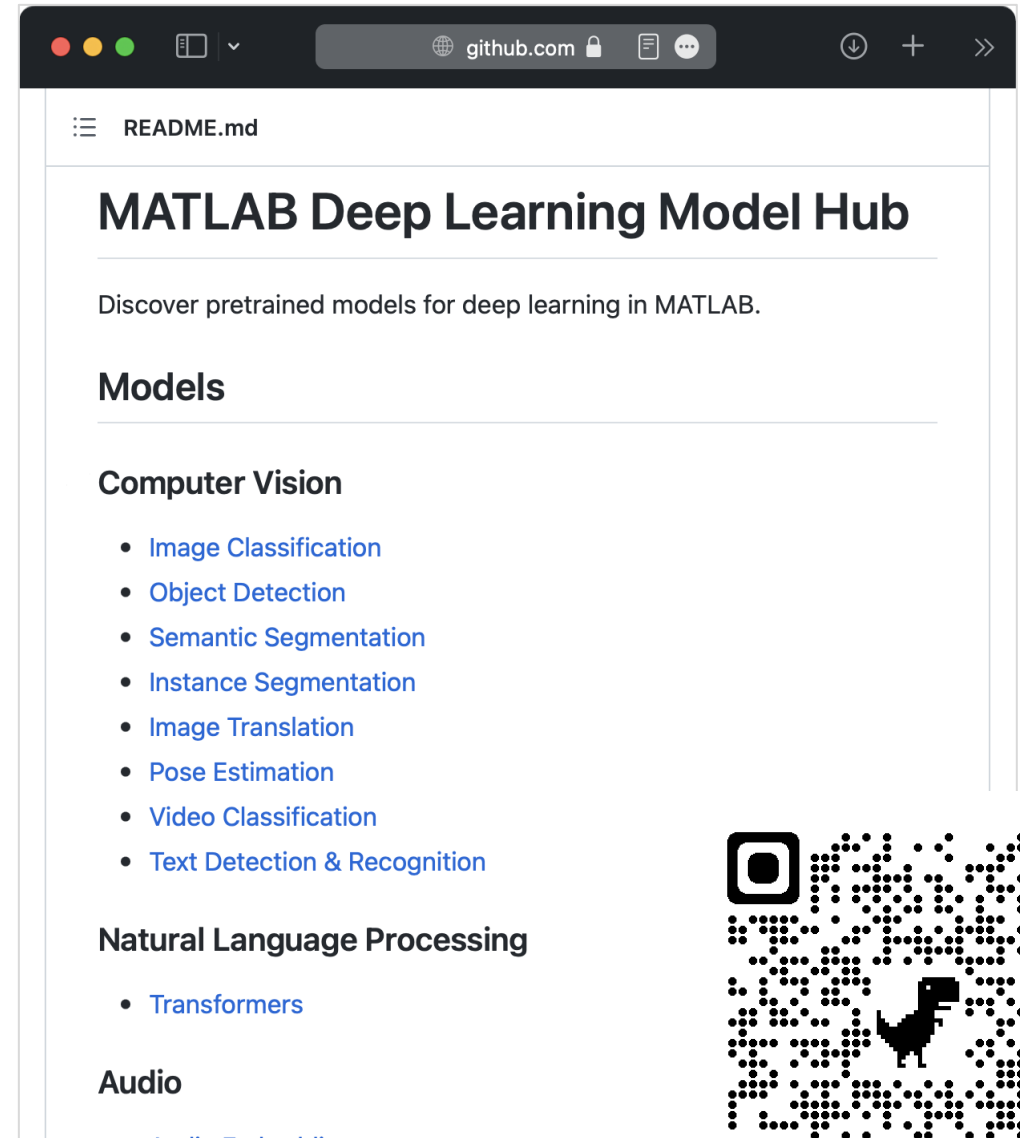
Deep Learning

Co-execution

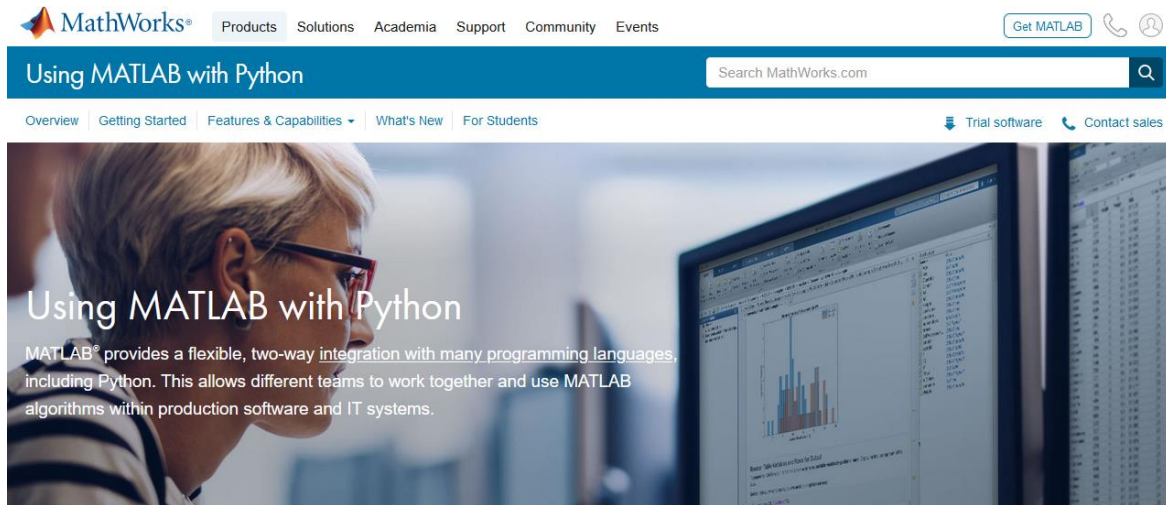


Model import/export

```
>> importTensorFlowNetwork("SavedModel")  
>> importONNXNetwork("model.onnx")  
>> exportONNXNetwork(net, "model.onnx")
```



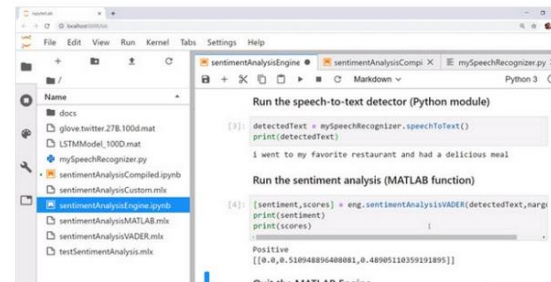
Resources



Calling MATLAB from Python

The MATLAB Engine API for Python allows you to call MATLAB as a computational engine from Python.

The API lets you execute MATLAB commands from within your Python environment without starting a desktop session of MATLAB. Learn more about the MATLAB Engine API for Python.




<https://www.mathworks.com/products/matlab/matlab-and-python.html>

- [Cheatsheet](#)
- [Example on GitHub](#)
- [Blog post](#)
- Videos
 - [Calling Python from MATLAB](#)
 - [Calling MATLAB from Python](#)
 - [Using MATLAB with Python + Q&A](#) (YouTube live stream recording)
- Documentation
 - [Calling Python from MATLAB](#)
 - Calling MATLAB from Python via:
 - [MATLAB Engine API](#)
 - [MATLAB Compiler SDK](#)
 - [MATLAB Production Server](#)
 - Data management:
 - [Data type conversions](#)
 - [Working with Parquet files](#)
 - [MATLAB library for Apache Arrow](#)
 - [Deep Learning \(TensorFlow, PyTorch, etc\)](#)

Cheatsheet



Using MATLAB® and Python® Together

The  icon provides links to relevant sections of the MATLAB documentation to learn more.

Call Python in MATLAB

Access settings and status of Python interpreter:

```
>> pe = pyenv
```

Specify version to use:

```
>> pe = pyenv("Version",3.7)
```

Call Python modules and functions:

```
py.module_name.function_name
```

```
>> py.math.sqrt(42)
```

Pass keyword arguments

Use pyargs to pass keyword arguments

```
>>> foo(5,bar=42)
```


```
>> py.foo(5,pyargs('bar',42))
```

Reload modules

Reload the module after making updates:

```
>> py.importlib.reload(module)
```

Call MATLAB in Python

Install MATLAB Engine API for Python 

Run `setup.py` from an OS command window

```
$ cd [matlabroot]/extern/engines/python
```

```
$ python setup.py install
```

Call MATLAB functions

Import the module and start the engine

```
>>> import matlab.engine
```

```
>>> eng =
    matlab.engine.start_matlab()
```

Call functions through the engine

```
>>> x = eng.sqrt(42.0)
```

Capture multiple outputs

```
>>> x = eng.gcd(42.0,8.0,nargout=3)
```

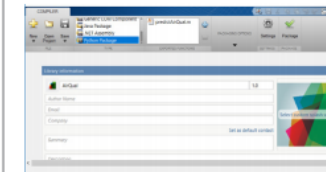
Stop the engine

```
>>> eng.exit()
```

Create Python Package

Package MATLAB functions 

Use the Library Compiler App to create a Python package for MATLAB functions



Invoke MATLAB functions from the Python package

```
>>> import PackageName
```

```
>>> pkg =
```

```
PackageName.initialize()
```

```
>>> result = pkg.foo()
```

Close package

```
>>> pkg.terminate()
```

NEW MATLAB for Python Users Cheat Sheet



MATLAB® for Python® Users

The MATLAB language is designed primarily for math-intensive scientific computing. MATLAB combines a desktop environment tuned for iterative analysis with a programming language that expresses matrix and array mathematics directly. Understanding the philosophy and API design can help while learning MATLAB.

» General Behavior

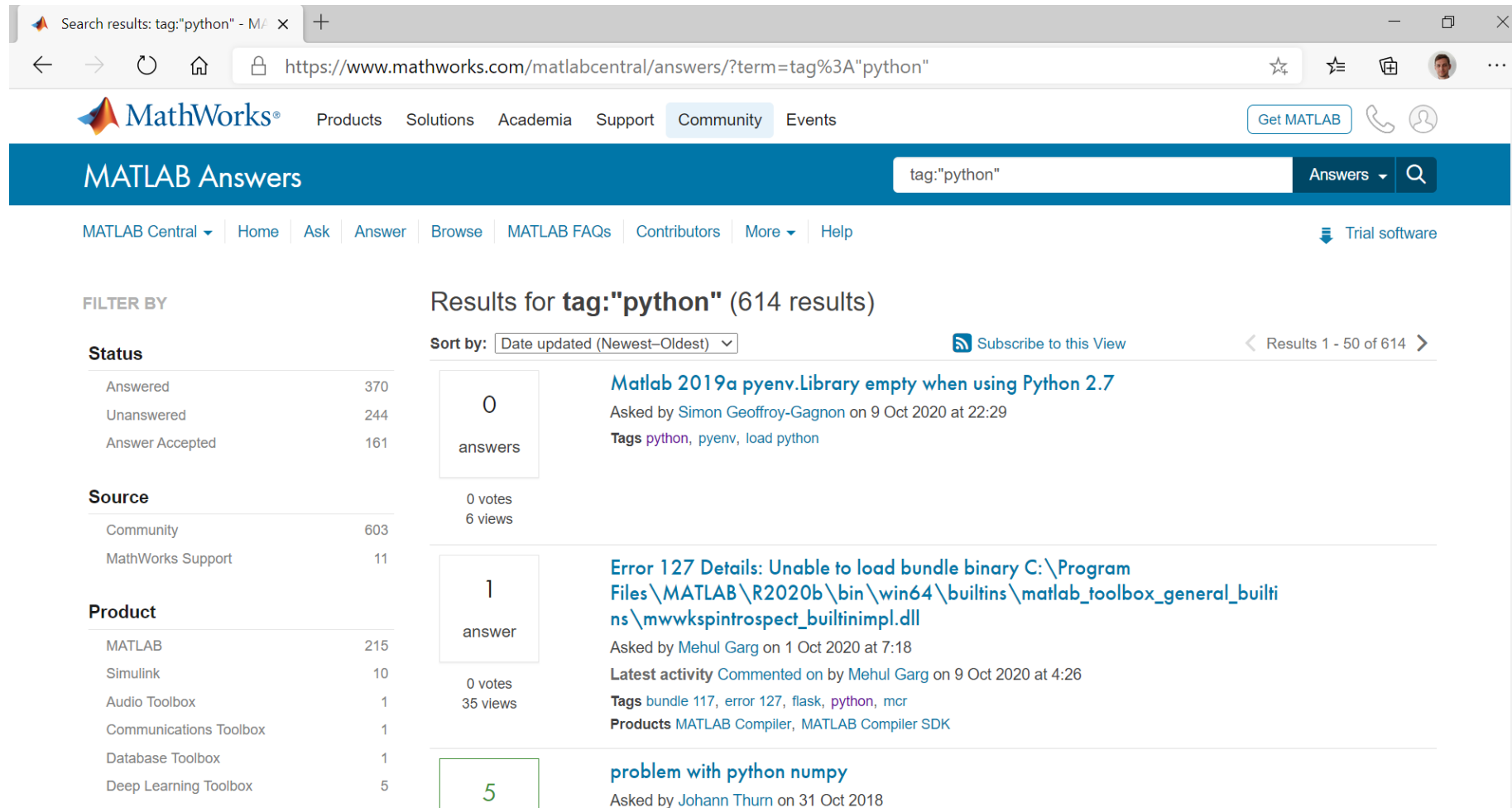
Python Syntax	MATLAB Syntax	Purpose	MATLAB Examples
#	%	Comment	%hello
print	Do not terminate with;	Print output	x
/	...	Continue to next line	x = 1+...2;
os	!	Operating system command	! echo hi
+ - * /	+ - * /	Mathematical operators	x = 1+2
**	^	Exponent	x = y^2
* / **	.* ./ .^	Element-wise operators	x = [1 2].* [3 4]
not, and, or	~ &	NOT, AND, OR logical operators	if x<2 & x>2
del	clear	Clear variable from memory	clear x y
clear	clc	Clear command window	clc

» Referencing

MATLAB Syntax	Purpose	Example
()	Index (copy-on-write)	x(1,1)
[]	Create array	x = [1 2 3]
	Join arrays	z = [x ; y]
{ }	Create cell arrays	x = {42; "hello world"}
	Extract contents from a container	x{1,1}
.	Access class property or method	obj.Data
	Reference table or struct field	t.FieldName

- Beginning element has an index of 1.
- Indexing is left and right inclusive.
- Indexing options include N-D indexing (row,col), linear indexing (element number), and logical indexing (conditional statement).

MATLAB Answers – tag:"python"



The screenshot shows the MATLAB Answers website interface. The browser address bar displays the URL: <https://www.mathworks.com/matlabcentral/answers/?term=tag%3Apython>. The page header includes the MathWorks logo and navigation links: Products, Solutions, Academia, Support, Community, and Events. A search bar in the header contains the text "tag:'python'". Below the header, the page is titled "MATLAB Answers" and shows "Results for tag:'python' (614 results)".

On the left side, there is a "FILTER BY" section with three categories:

- Status**
 - Answered: 370
 - Unanswered: 244
 - Answer Accepted: 161
- Source**
 - Community: 603
 - MathWorks Support: 11
- Product**
 - MATLAB: 215
 - Simulink: 10
 - Audio Toolbox: 1
 - Communications Toolbox: 1
 - Database Toolbox: 1
 - Deep Learning Toolbox: 5
 - Embedded Coder: 4

The main content area displays three search results:

- Matlab 2019a pyenv.Library empty when using Python 2.7**
Asked by Simon Geoffroy-Gagnon on 9 Oct 2020 at 22:29
Tags: python, pyenv, load python
0 answers, 0 votes, 6 views
- Error 127 Details: Unable to load bundle binary C:\Program Files\MATLAB\R2020b\bin\win64\builtins\matlab_toolbox_general_builtins\mwwkspintrospect_builtinimpl.dll**
Asked by Mehul Garg on 1 Oct 2020 at 7:18
Latest activity: Commented on by Mehul Garg on 9 Oct 2020 at 4:26
Tags: bundle 117, error 127, flask, python, mcr
Products: MATLAB Compiler, MATLAB Compiler SDK
1 answer, 0 votes, 35 views
- problem with python numpy**
Asked by Johann Thurn on 31 Oct 2018
5 answers

<https://www.mathworks.com/matlabcentral/answers/?term=tag%3A%22python%22>

Python libraries in MATLAB (1)

Directly call Python® functionality from MATLAB®

Using Python Libraries

- **Access Python Modules from MATLAB - Getting Started**
 - How to create and use a Python object in MATLAB.
- **Configure Your System to Use Python**
 - How to verify you have installed a supported version of Python.
- **Call User-Defined Python Module**
 - Create a Python module used by examples in this documentation.
- **Understand Python Function Arguments**
 - Python method syntax which might be unfamiliar to MATLAB users.
- **Advanced Topics**
 - Code pattern differences you should be aware of.
- **Out-of-Process Execution of Python Functionality**
 - Execute Python scripts in processes that are separate from the MATLAB process.
- **Reload Out-of-Process Python Interpreter**
 - Reload out-of-process Python interpreter without restarting MATLAB.

```

tw = py.textwrap.TextWrapper(pyargs(...
    'initial_indent', '% ', ...
    'subsequent_indent', '% ', ...
    'width', int32(30)));
wrapped = wrap(tw,T);
wrapped = cellfun(@char,...
    cell(wrapped),...
    'UniformOutput',false);
fprintf('%s\n', wrapped{:})
% Customize the output of the
% paragraph using keyword
% arguments.
% >> |

```

Call Python Function in MATLAB to Wrap Paragraph Text

Use Python language functions and modules within MATLAB. The example calls a text-formatting module from the Python standard

[Open Live Script](#)

Python libraries in MATLAB (2)

Directly call Python® functionality from MATLAB®

Passing Data

- **MATLAB to Python Data Type Mapping**
 - How MATLAB converts MATLAB data into compatible Python data types.
- **Access Elements in Python Container Types**
 - A Python container is typically a sequence type (list or tuple) or a mapping type (dict).
- **Pass Python Function to Python map Function**
 - This example shows how to display the length of each word in a list.

```
>> %Use Python array Types in MATLAB
P = py.array.array('d', 1:5)

P =

Python array:

    1     2     3     4     5

Use details function to view the properties of the Py
Use double function to convert to a MATLAB array.
```



Use Python Numeric Variables in MATLAB

Use Python numeric variables with MATLAB.

[Open Live Script](#)

```
F = py.os.listdir(folder)

F =

Python list with no properties.

['5g', 'aero', 'aeroblks_produ
```



Use Python str Variables in MATLAB

Use Python str variables with MATLAB.

[Open Live Script](#)

```
listVar = py.list(...)
{'Name 1', 'Name 2', 'Name 3'}

listVar =

Python list with no properties

['Name 1', 'Name 2', 'Name 3']
```



Use Python list Variables in MATLAB

Use Python list variables with MATLAB.

[Open Live Script](#)

```
tupleVar = py.tuple(...)
{'Name', 'Subject', 95}

tupleVar =

Python tuple with no properties

('Name', 'Subject', 95.0)
```



Use Python tuple Variables in MATLAB

Use Python tuple variables with MATLAB.

[Open Live Script](#)

```
dict(pyargs('Name1', 357, 'Name2', 229.0))

dict =

Python dict with no properties.

{'Name2': 229.0, 'Name1': 357.0}
```



Use Python dict Variables in MATLAB

Use Python dict variables with MATLAB.

[Open Live Script](#)

Additional resources

Resources

- General:
 - <https://www.mathworks.com/products/matlab/matlab-and-python.html>
- Python from MATLAB:
 - <https://www.mathworks.com/help/matlab/call-python-libraries.html>
- MATLAB from Python:
 - MATLAB Engine API:
 - <https://www.mathworks.com/help/matlab/matlab-engine-for-python.html>
 - MATLAB Compiler SDK:
 - https://www.mathworks.com/help/compiler_sdk/python_packages.html
 - Data type conversions:
 - <https://www.mathworks.com/help/matlab/python-data-types.html>
- Example:
 - <https://github.com/mathworks/matlab-with-python>