Using MATLAB with Python

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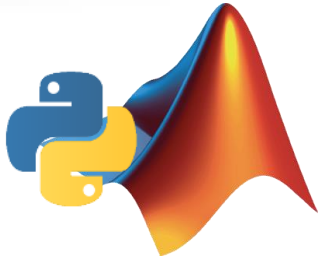

Date : 27th Jan 2023

Time : 09:00 – 11:00

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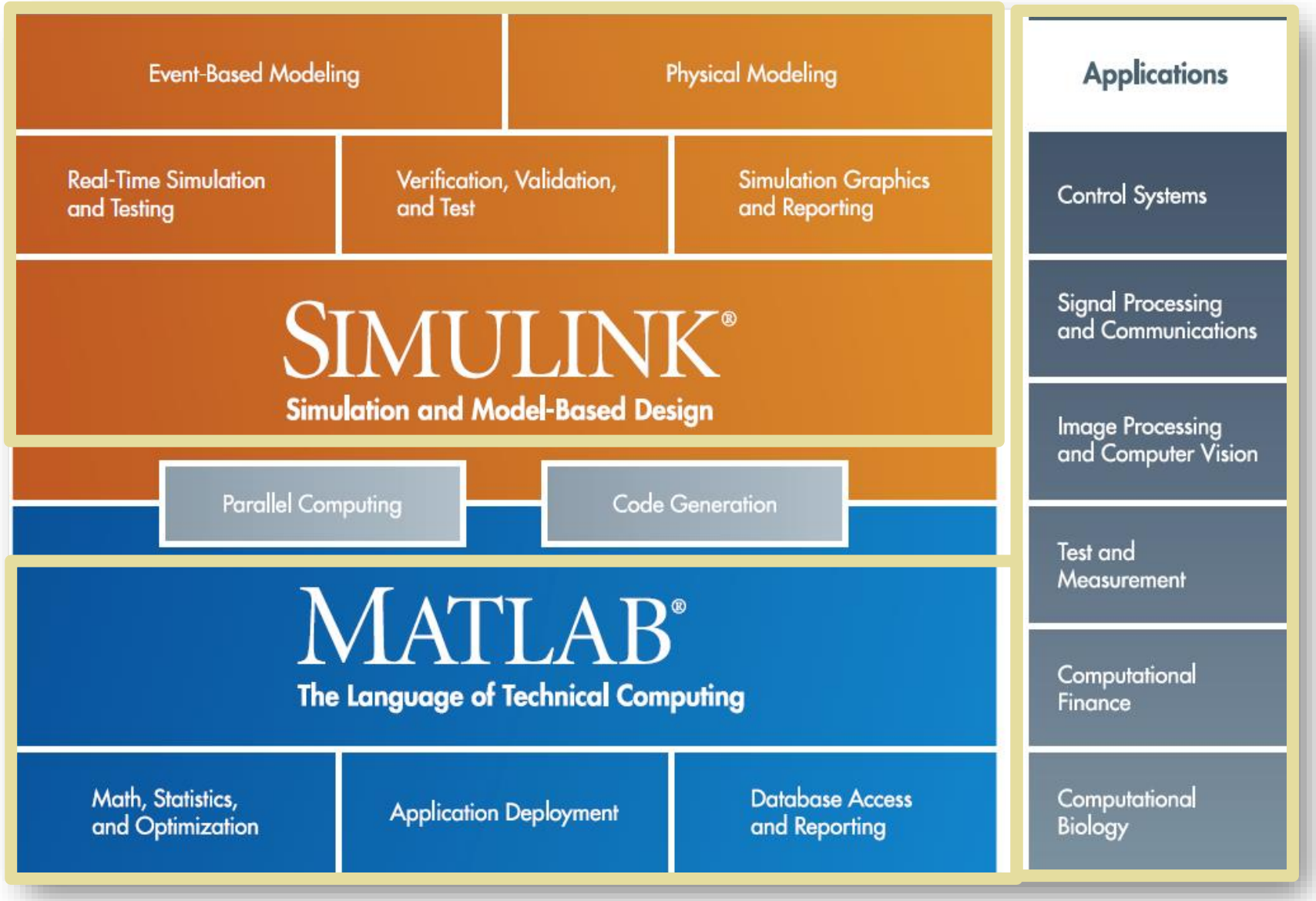

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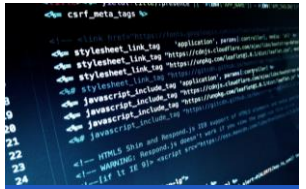
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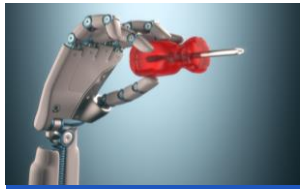
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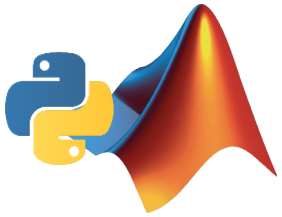


“Using MATLAB with Python“

Agenda (2hr)

- Introduction MATLAB and Python	09:00 - 09:30 (15min)
- Co-execution multiple languages	09:30 - 09:45 (15min)
- Call Python from MATLAB	09:45 - 10:00 (15min)
- Short Break	10:00 - 10:15 (15min)
- Call MATLAB from Python	10:15 - 10:35 (30min)
- Resources for further learning	10:35 - 10:50 (15min)
- Q&A	10:50 – 11:00 (10min)

What’s new in MATLAB

Teach with MATLAB Live Editor

MATLAB in an Executable Notebook

Use live scripts to create engaging lectures that combine explanatory text, mathematical equations, code, and results

Share live scripts directly with colleagues or students

Work in a single environment to eliminate context switching

Use data to tell a story – Live Scripts

```
% pulse of input DC current (stimulation parameters)
params.stm.pulseWidth = 0.8;
params.stm.pulseAmpl = 70;
params.mem.C = 140;          % membrane capacitance
params.mem.vr = -60;         % resting membrane potential
params.mem.vt = -52;         % instantaneous threshold potential
params.mem.a = 0.01;         % recovery time constant
params.mem.b = -0.9;         % determines whether u is amplifying (b<0) or resonar
params.mem.c = -40;          % voltage reset value
params.mem.d = 170;          % total outward-inward current during spike
params.mem.vpeak = 17;       % spike cutoff

% initialize/calculate some parameters
T = 1000; tau = 1; % total time of simulation and time step
n = round(T/tau); % simulation time steps
```

- MATLAB code and related output together
- Text, pictures, graphics and equations inline
- UI controls for users to select options
- Export to html, latex, word, pdf

```
    end
```

- Communicate your research (Lab meetings, collaborators)
- Allow others to interact with your code
- Upload code, documentation & results together

```
ylabel('membrane potential')
```

Spiking model of cortical neurons

This live script is an attempt to reproduce the neuronal dynamics of most cortical neurons by using the Izhikevich model of spiking neurons. It is biologically as plausible as the Hodgkin-Huxley model, yet computationally viable like the integrate-and-fire models. For more information, please see the original paper of Eugene Izhikevich [*IEEE Trans on Neural Networks, 14(6), 2003*] as well as the project report of Ahmed Salem from the University of Edinburgh, School of Informatics.

1 The spiking model

1.1 Spiking model equation of Izhikevich

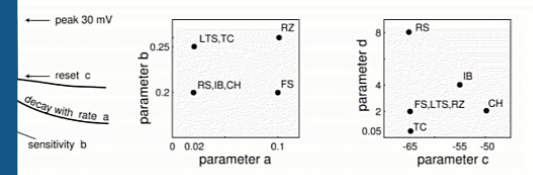
The spiking model of cortical neurons is based on the following equations

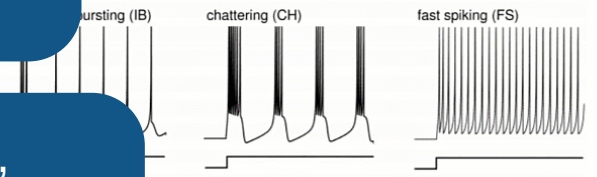
$C\dot{v} = k(v - v_r)(v - v_t) - u + I$ .....[1]

$\dot{u} = a\{b(v - v_r) - u\}$ .....[2]

If $v \geq v_{peak}$, then $v = c, u = u + d$ .....[3]

...the membrane potential, C is the membrane capacitance and u is the membrane recovery variable. v_r is the resting membrane potential and v_t is the instantaneous spiking ...arge diversity of cortical neurons can be simulated by setting the membrane parameters a, b, c & d appropriately (see figure below).





...s of the model

...rrent parameters

...hat is injected

```
...idth =  0.7 ;
...mpl = 70;
```

...rameters

...eters of the model a, b, c & d control various membrane properties and affect spiking behavior. They are

- a = recovery time constant
- b = determines whether recovery variable, u, is an amplifying (b < 0) or a resonant (b > 0) variable.
- c = voltage reset value following spiking

mathworks.com/products/matlab/live-editor.html

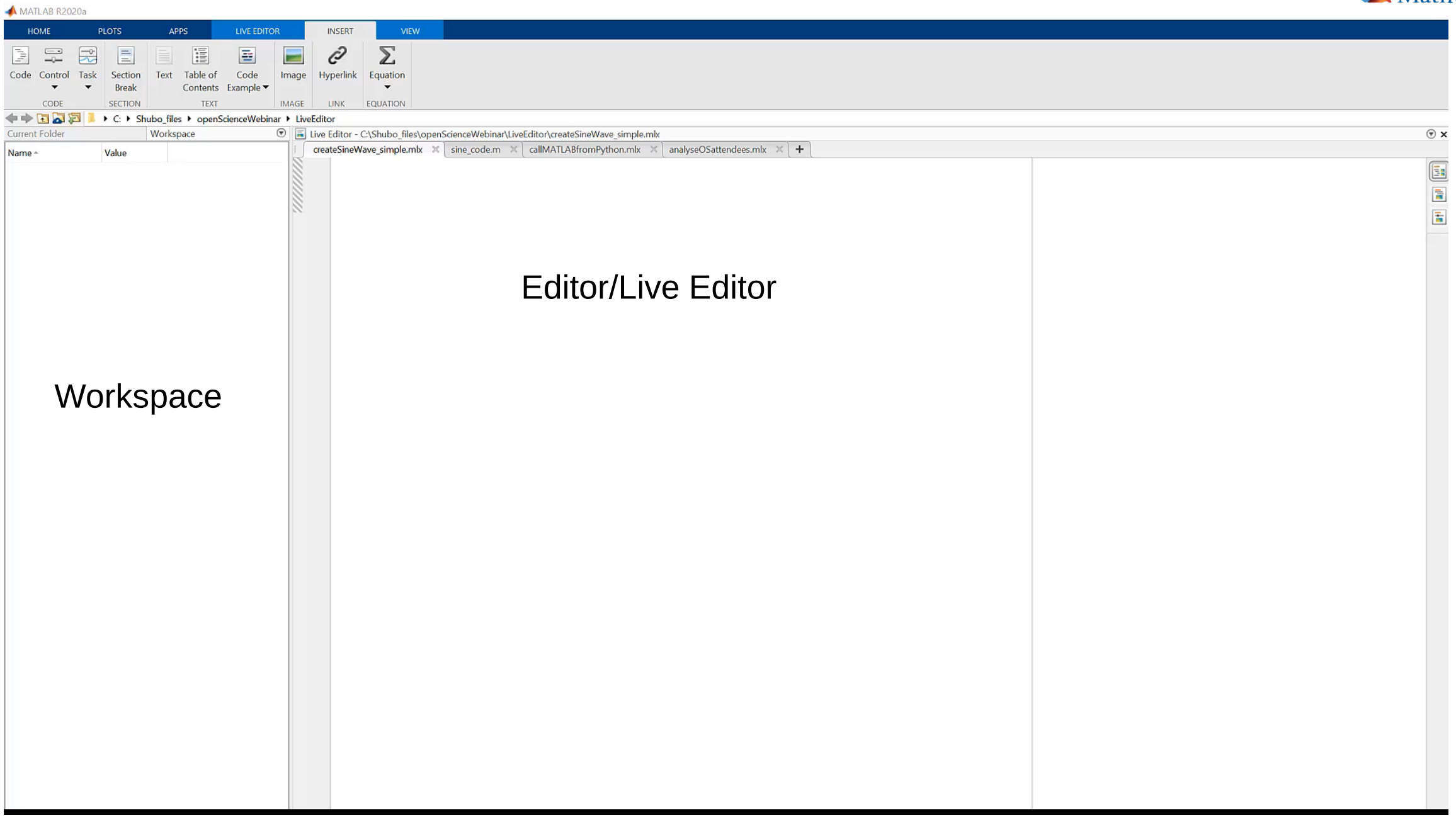

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Table of Contents
Code Example
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Equation
CODE
SECTION
TEXT
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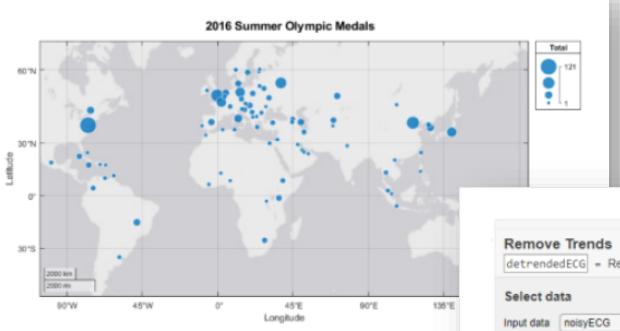
Current Folder
Workspace
Name
Value
Live Editor - C:\Shubo_files\openScienceWebinar\LiveEditor\createSineWave_simple.mlx
createSineWave_simple.mlx
sine_code.m
callMATLABfromPython.mlx
analyseOSattendees.mlx
Workspace
Editor/Live Editor

The Live Script Gallery

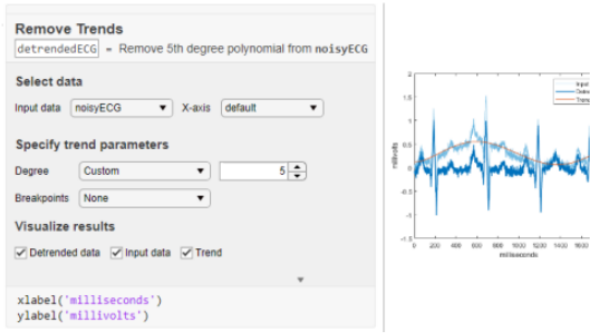


GDP and Olympic Success

by David Garrison

Run this example

View on File Exchange



Calculate Heart Rate from Electrocardiogram Data

by Heather Gorr

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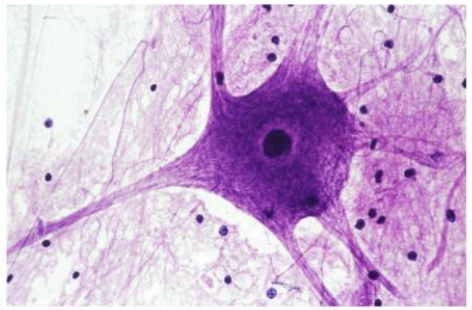
View on File Exchange



Inside the Brain: Modelling the Neuron

by Davide Borra

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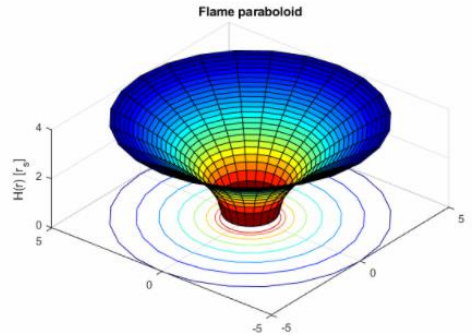
View on File Exchange



Schwarzschild metric and black holes (Computational example)

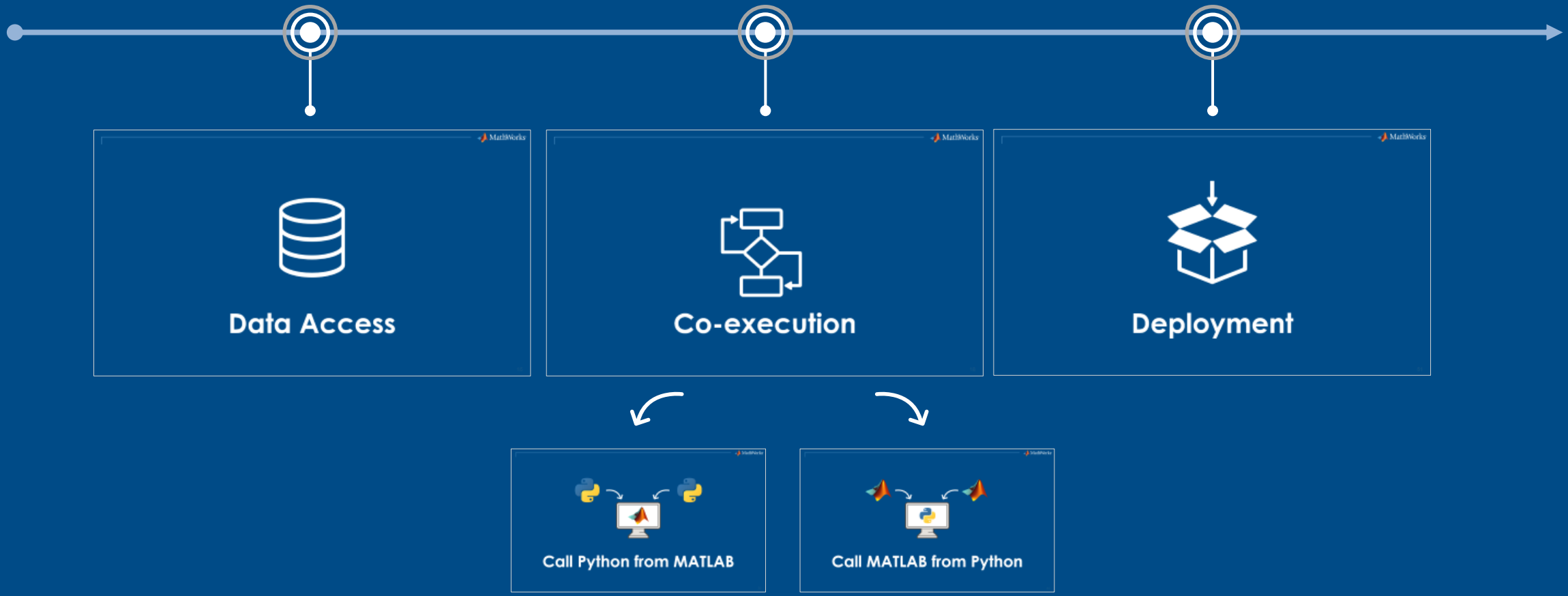
by Kurt Braeuer

Run this example

View on File Exchange

https://www.mathworks.com/products/matlab/live-script-gallery.html

Plan


Data Access
Co-execution
Deployment
Call Python from MATLAB
Call MATLAB from Python

Data Access

Setup tips

- Use **`pyenv`** to update settings (**`pyversion`** before R2019b)
- Ensure all code is on path
- Check environment settings, depending on how you set up python

- How to select the MATLAB engine version if I have multiple MATLAB releases to interface?

Setup

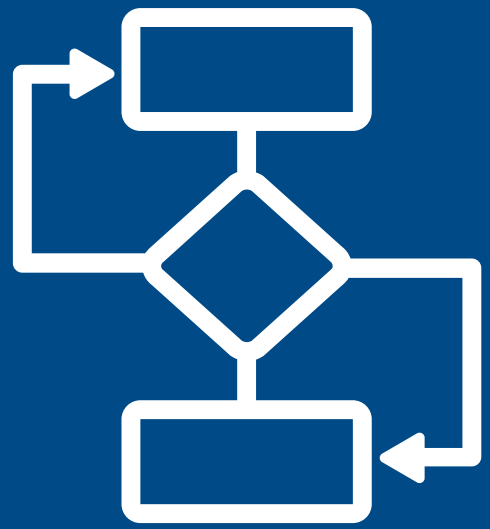
Ensure Python is installed and confirm the version with `pyenv`.

We will provide the path to the correct executable for MATLAB Online.

```
pyenv
```

```
ans =
  PythonEnvironment with properties:

         Version: "3.9"
      Executable: "C:\Users\KantikaWongkasem\anaconda3\python.EXE"
         Library: "C:\Users\KantikaWongkasem\anaconda3\python39.dll"
            Home: "C:\Users\KantikaWongkasem\anaconda3"
          Status: Loaded
   ExecutionMode: OutOfProcess
       ProcessID: "4668"
     ProcessName: "MATLABPyHost"
```



Co-execution

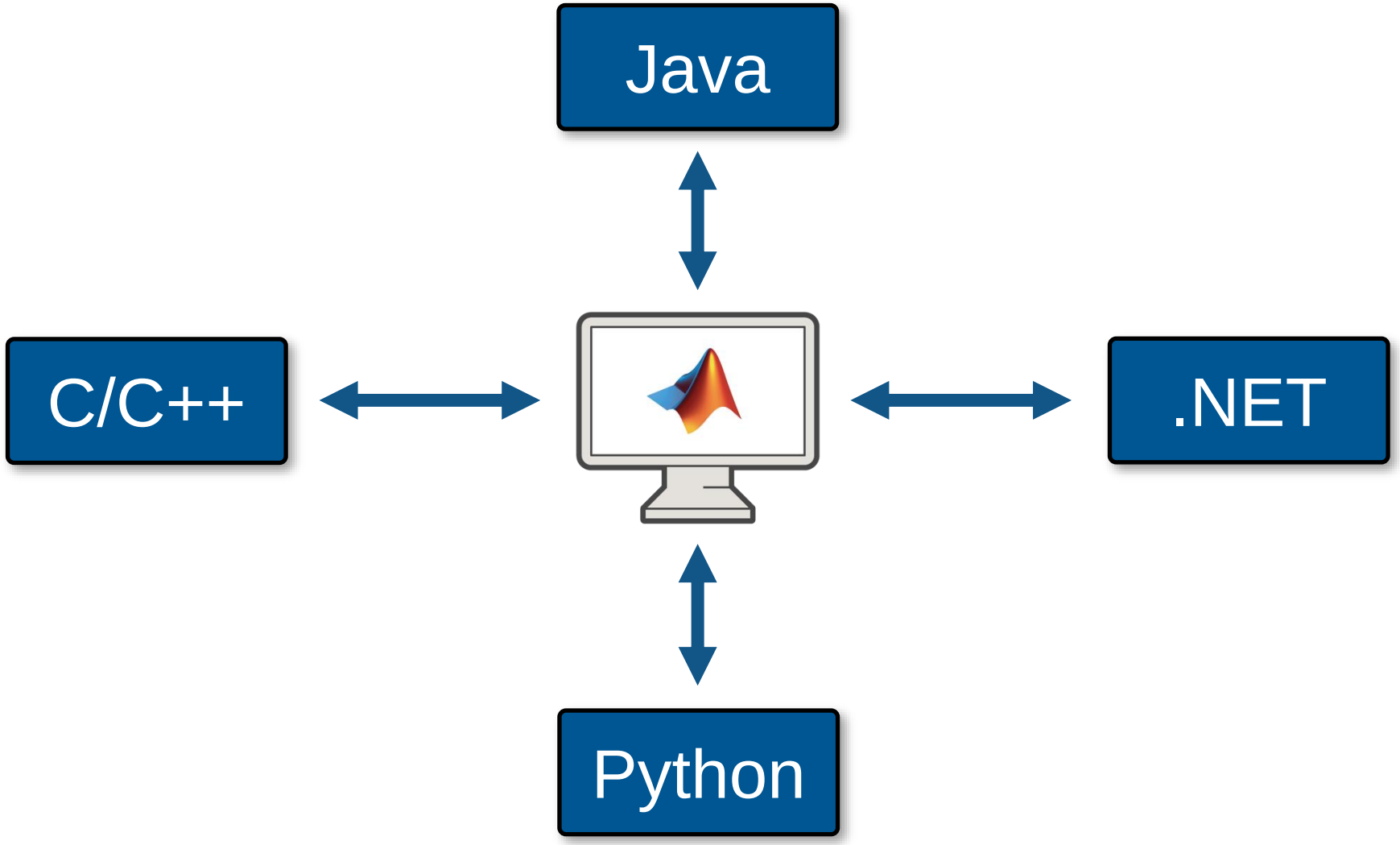
Data Access

Co-Execution

- Call Python from MATLAB
- Call MATLAB from Python

Deployment

MATLAB provides flexible integration with multiple languages



Given: Existing Python Code accessing & preparing weather data

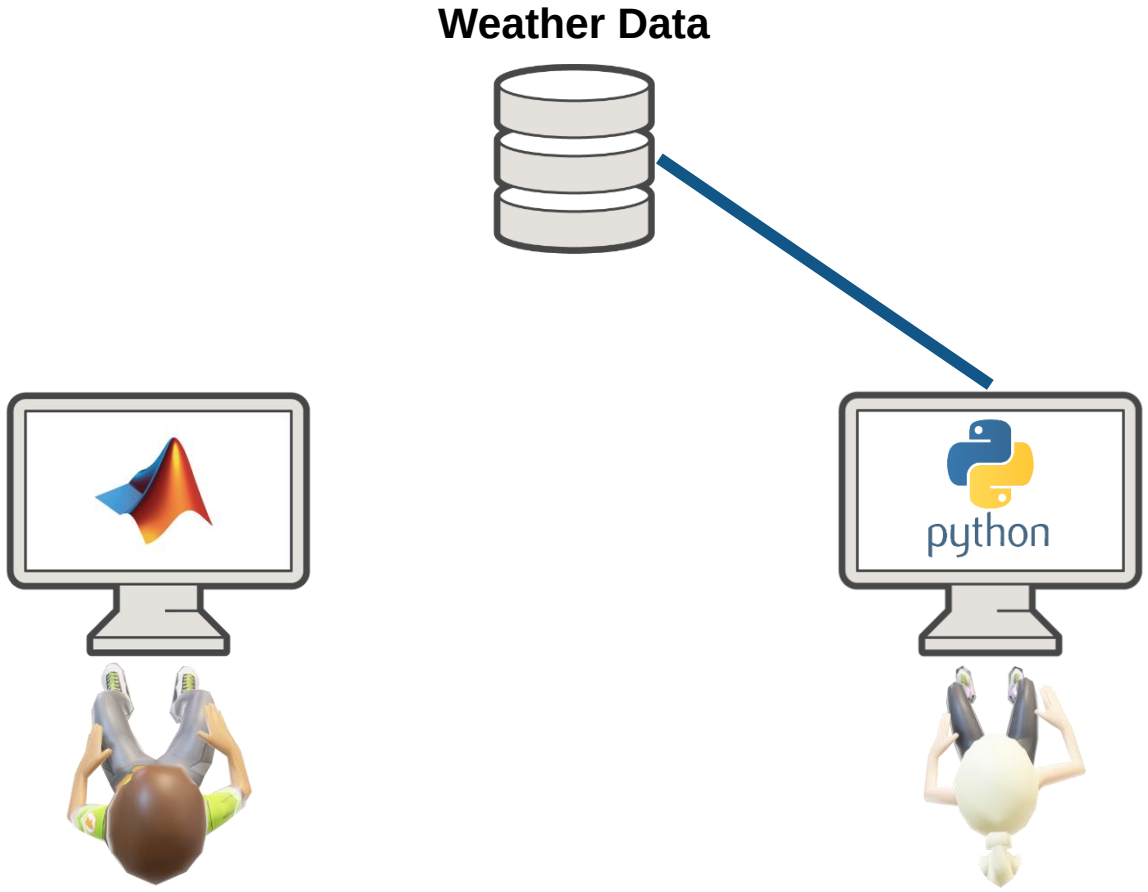
Data preparation | Modeling | Deployment

Data Access

Co-Execution

- Call Python from MATLAB
- Call MATLAB from Python

Deployment



Call Python from MATLAB

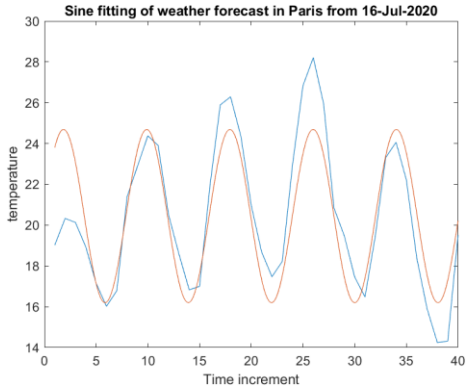
Data preparation | Modeling | Deployment

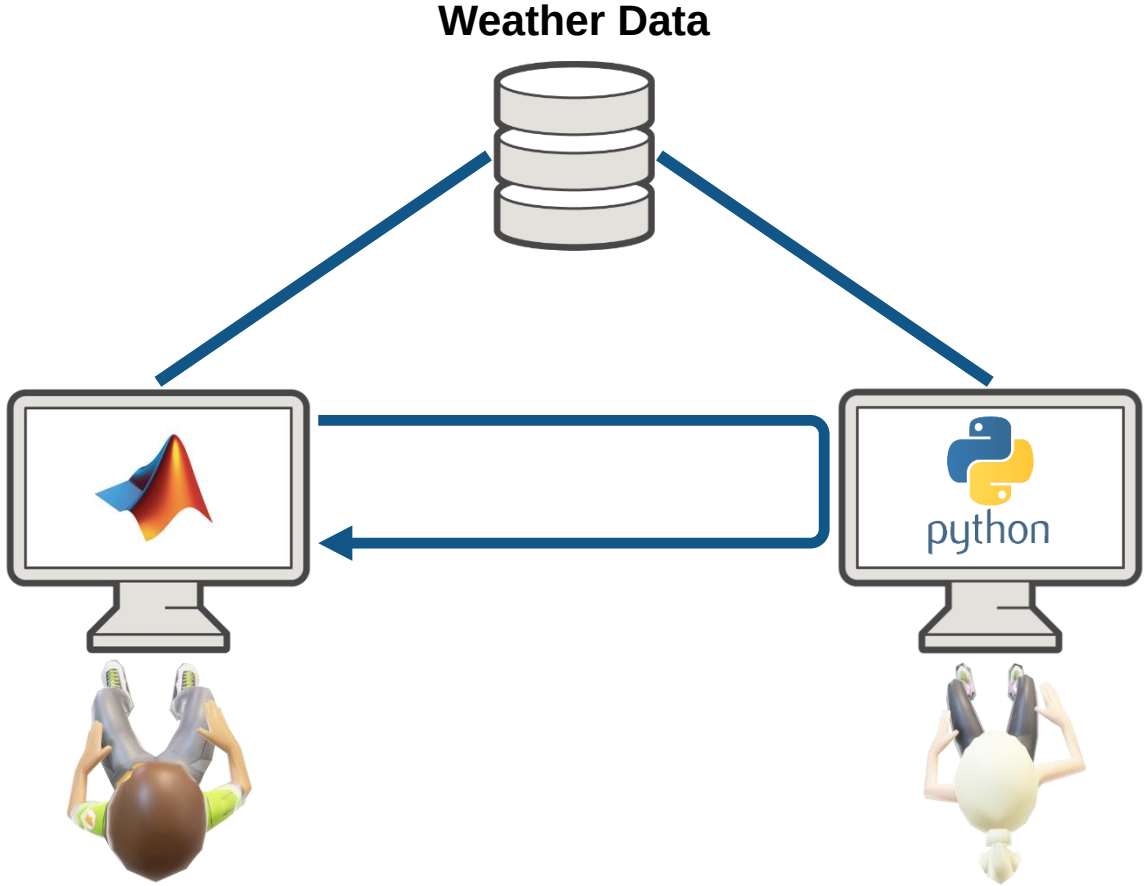
Data Access

Co-Execution

- Call Python from MATLAB
- Call MATLAB from Python

Deployment





Call MATLAB from Python

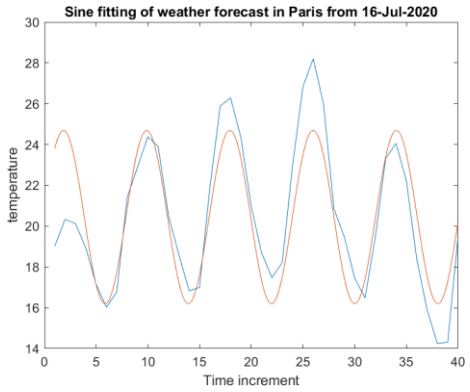
Data preparation → Modeling → Deployment

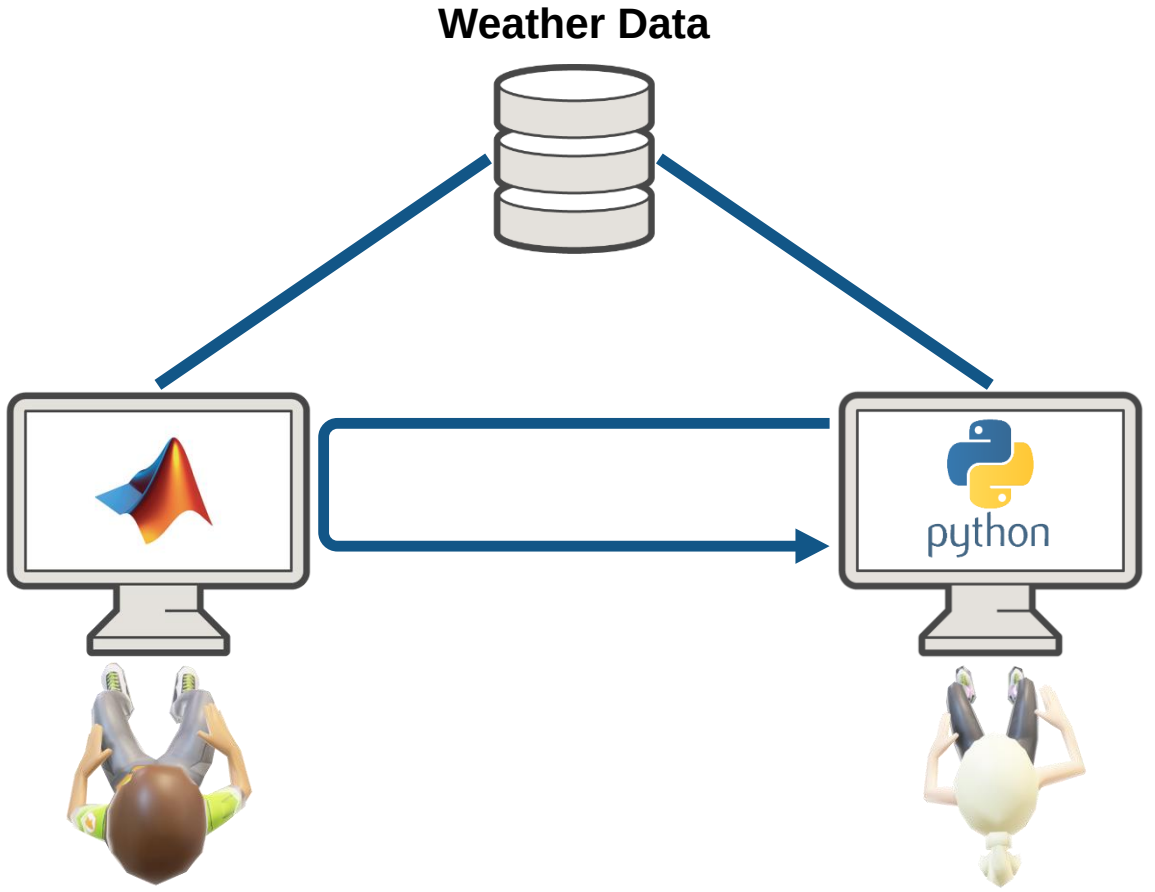
Data Access

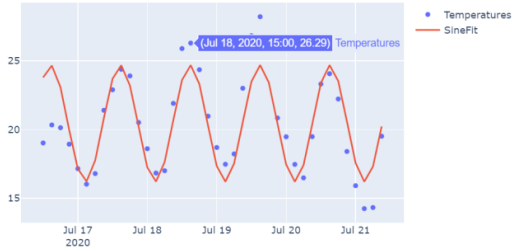
Co-Execution

- Call Python from MATLAB
- Call MATLAB from Python

Deployment







Deploy:
MATLAB Analytics into Python

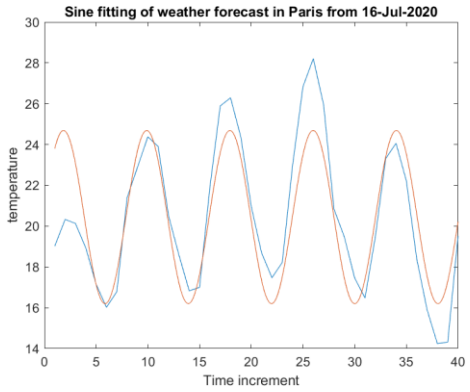
Data preparation → Modeling → Deployment

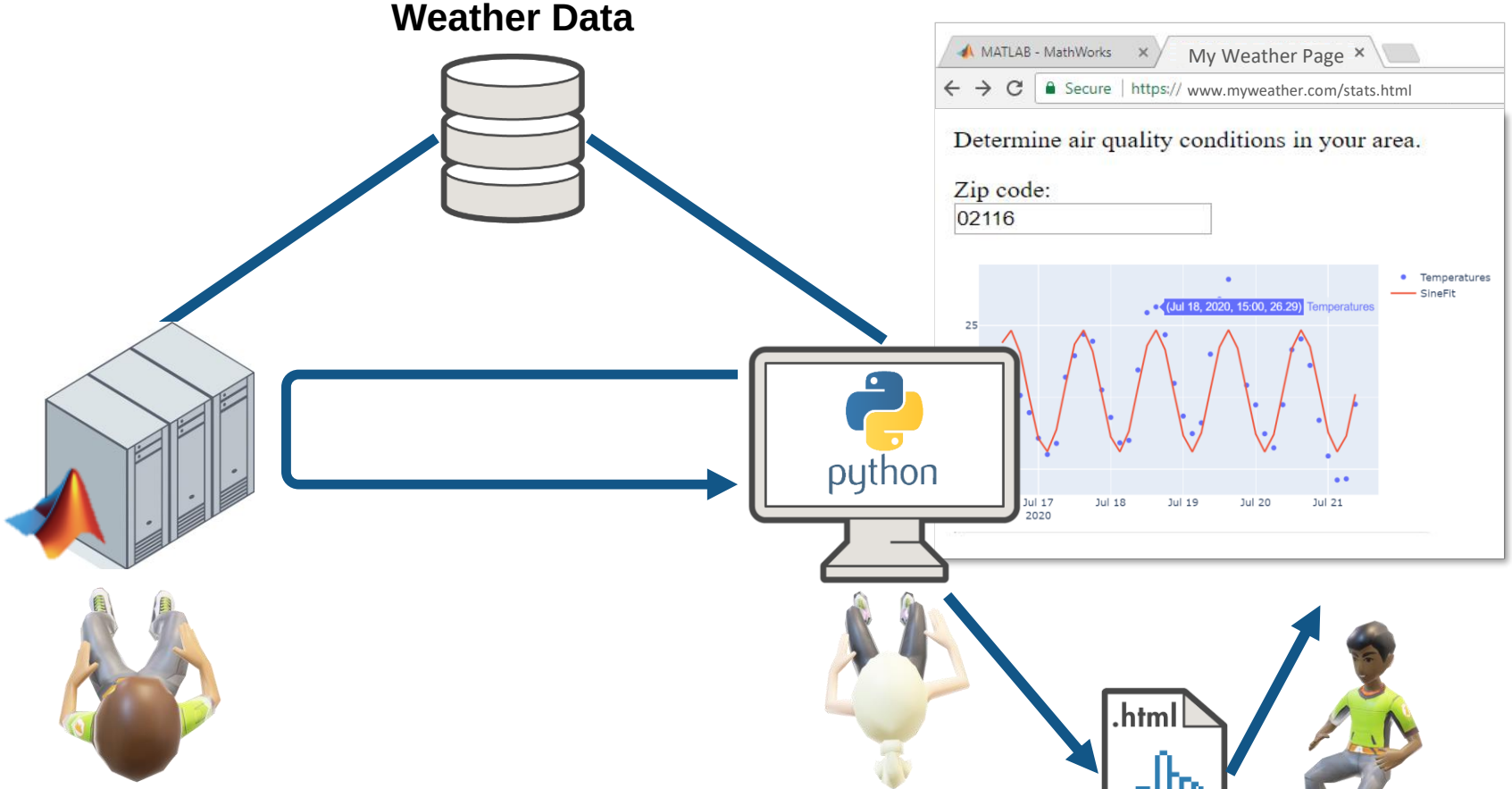
Data Access

Co-Execution

- Call Python from MATLAB
- Call MATLAB from Python

Deployment





Deploy:
MATLAB Analytics into Python

Data preparation → Modeling → Deployment

Data Access

Co-Execution

- Call Python from MATLAB
- Call MATLAB from Python

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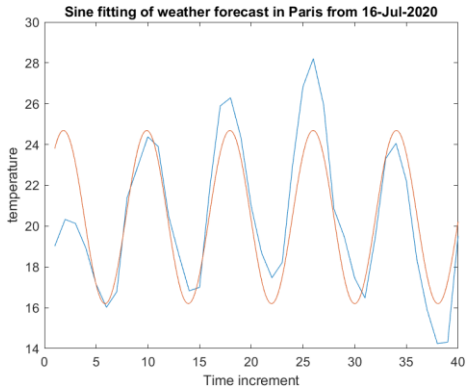
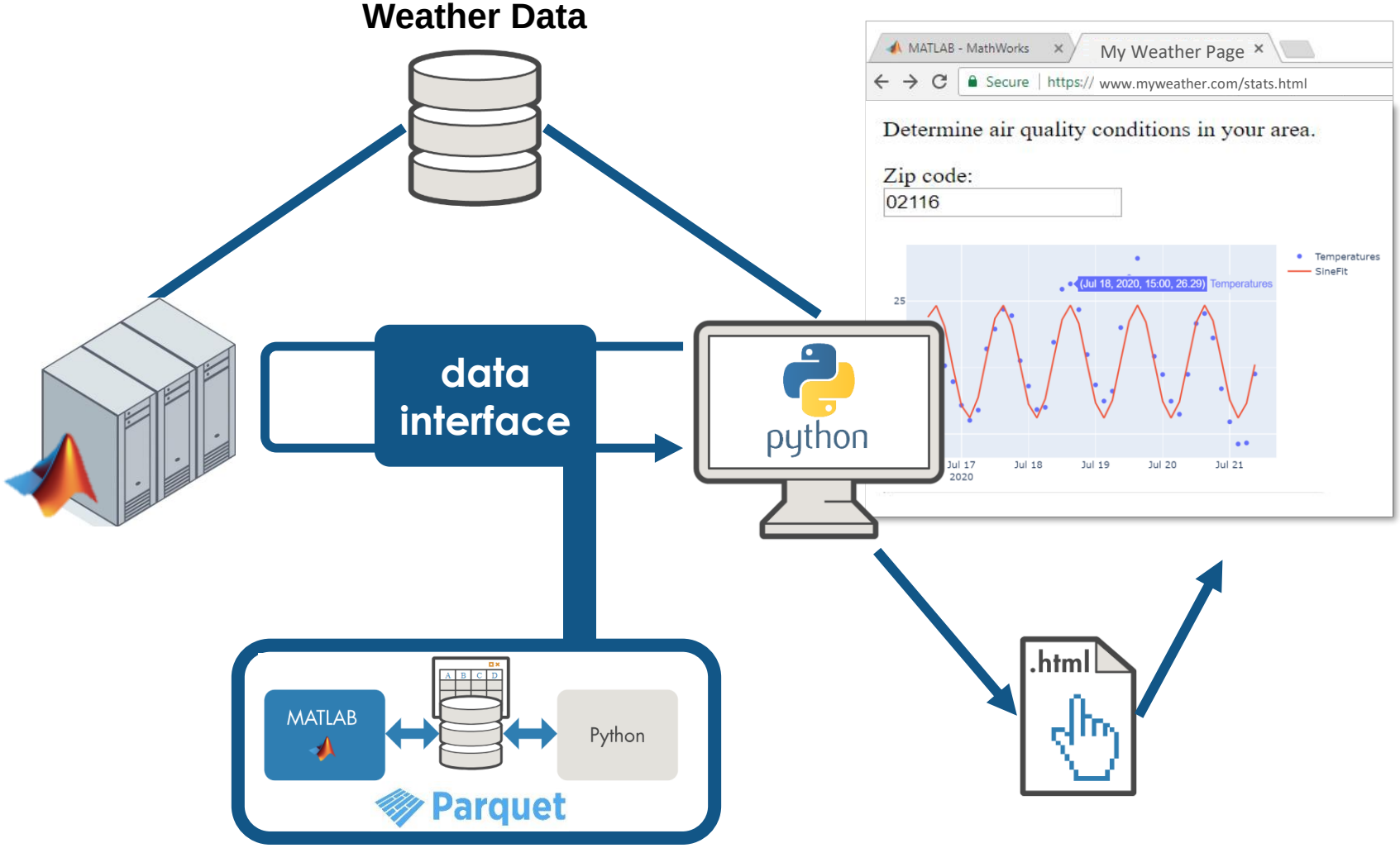
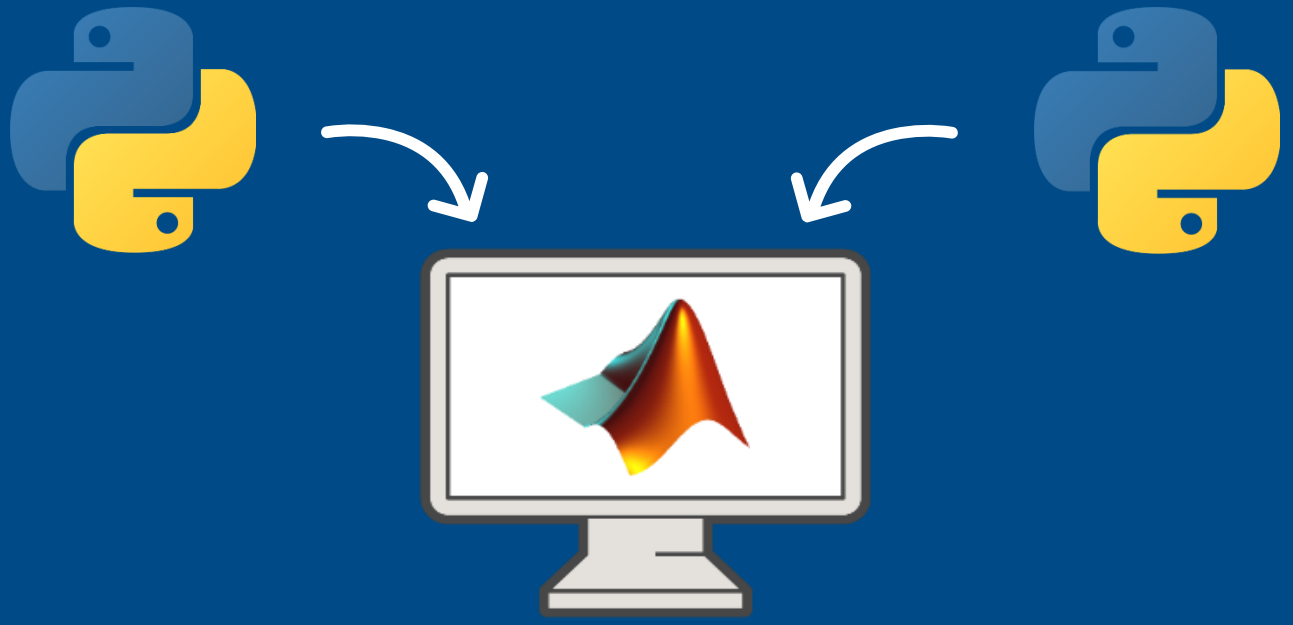






Call Python from MATLAB

Create List, Tuple, and Dictionary Types

- *This table shows the commands for creating `list, tuple, dict` types. The commands on the left are run from the Python interpreter. The commands on the right are MATLAB commands*

Python list — []	**MATLAB py.list**
>>> [‘Kantika’, ‘Wongkasem’, ‘Fah’]	>> py.list({‘Kantika’,’Wongkasem’,’Joseph’})
>>> [[1,2],[3,4]]	>> py.list({py.list([1,2]),py.list([3,4])})

Python tuple — ()	**MATLAB py.tuple**
>>> (‘Kantika’, 27, ‘Engineer’)	>> py.tuple({‘Kantika’,19,’Engineer’})

Python dict — {}	**MATLAB py.dict**
>>> {‘Ink’: 424 , ‘Pink’: 543 , ‘Blue’: 320}	>>py.dict(pyargs(‘Ink’,424,’Pink’,543,’Blue’,320))
	For information about passing keyword arguments, see ***`pyargs`***

Access Python Standard Library Modules in MATLAB

- Create a Python `list` datatype:

```
l = py.list({'Kantika','Wongka','Fah'})
```

```
l =
  Python list with values:

    ['Kantika', 'Wongka', 'Fah']

    Use string, double or cell function to convert to a MATLAB array.
```

```
l.append('Engineer')
l
```

```
l =
  Python list with values:

    ['Kantika', 'Wongka', 'Fah', 'Engineer']

    Use string, double or cell function to convert to a MATLAB array.
```

- MATLAB recognizes Python objects and automatically converts the MATLAB cell array to the appropriate Python type.

- To convert the list variable to a MATLAB variable, call `cell` on the list and `string` on the elements of the list

```
myl = cellfun(@string,cell(l))
```

```
myl = 1×4 string
   "Kantika"    "Wongka"    "Fah"       "Engineer"
```

```
cell(l)
```

```
ans = 1×4 cell
```

	1	2	3	4
1	1×7 str	1×6 str	1×3 str	1×8 str

Call User-Defined Python Module(1)

This example shows how to call methods from following Python module:

Editor - D:\DriveD\Kantika W\Edu\Python Webinar\MATLABwithPythonWorkshopExpo\mymod.py

```
# mymod.py
"""Python module demonstrates passing MATLAB types to Python functions"""
def search(words):
    """Return list of words containing 'ka'"""
    newlist = [w for w in words if 'ka' in w]
    return newlist

def engineer(words):
    """Append 'Engineer' to list of words"""
    words.append('Engineer')
    return words
```

Command Window

New to MATLAB? See resources for Getting Started.

```
>> l = py.list({'Kantika','Kittika','Fah'})

l =

  Python list with values:

    ['Kantika', 'Kittika', 'Fah']

    Use string, double or cell function to convert to a MATLAB array.

>> py.mymod.search(l)

ans =

  Python list with values:

    ['Kantika', 'Kittika']

    Use string, double or cell function to convert to a MATLAB array.
```

- ✓ How to use call mymod.py and To convert the list variable to a MATLAB variable

Command Window

New to MATLAB? See resources for Getting Started.

```
>> py.mymod.engineer(l)

ans =

  Python list with values:

    ['Kantika', 'Kittika', 'Fah', 'Engineer']

    Use string, double or cell function to convert to a MATLAB array.

>> cellfun(@string,cell(l))

ans =

  1×4 string array

    "Kantika"    "Kittika"    "Fah"    "Engineer"

>> cell(l)

ans =

  1×4 cell array

    {1×7 py.str}    {1×7 py.str}    {1×3 py.str}    {1×8 py.str}
```

Display Python Documentation in MATLAB

You can display help text for Python functions in MATLAB. For example

```
>> py.help('list.append')
Help on method_descriptor in list:

list.append = append(self, object, /)
    Append object to the end of the list.
```

- Tab completion when typing `py.` Does not display available Python functionality. For more information,
- see Limitations to Python Support - MATLAB & Simulink (mathworks.com)

Call User-Defined Python Module(2)

If you create `mymod.py` in a Python editor, be sure that the module is on the Python search path

- From the MATLAB command prompt, add the current folder to the Python search path: `>> py.sys.path()`

```
if count(py.sys.path,pwd()) == 0
    insert(py.sys.path,int32(0),pwd());
end
```

- To learn how to call the function, read the function signature for the search function in the `mymod.py` source file. The function takes one input argument, `words`.

```
def search(words):
```

Reload Modified User-Defined Python Module

- **Create Python Module**

  Save the file `mymod.py`:

```
def myfunc():
    return 'version 1'
```

- **Modify Module**

  Modify the function:

```
    return 'version 2'
```

- **Unload Module**

```
>> clear classes
```

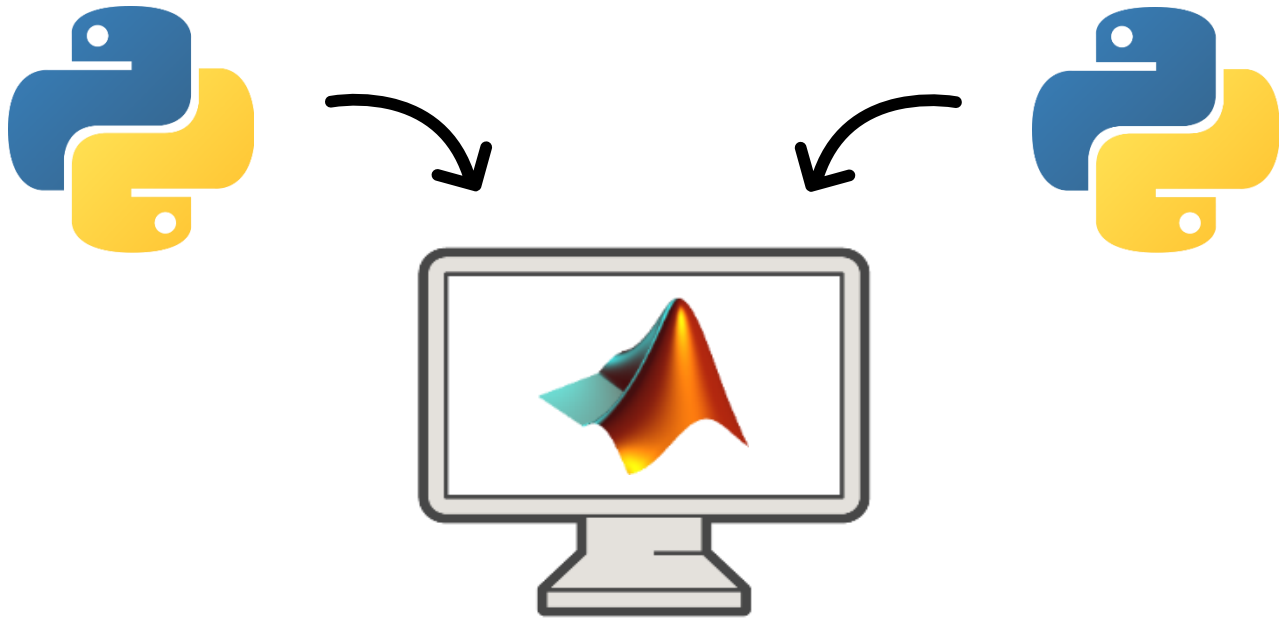
- **Import & Reload Modified Module**

```
>> mod = py.importlib.import_module('mymod');
>> py.importlib.reload(mod);
```

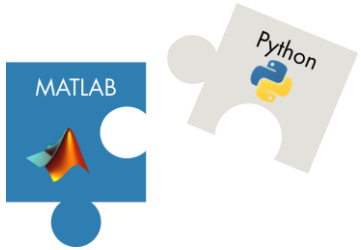
Why Call Python from MATLAB?

Already working in MATLAB, and:

- Want to reuse existing Python code
- Need functionality that is only available in Python



Calling Python libraries from MATLAB



Data Access

Co-Execution

- Call Python from MATLAB
- Call MATLAB from Python

Deployment

Use the weather.py module to get the air quality for Paris. This is a user-defined Python module which includes functions to read and parse the current and forecasted weather data by location.

```
jsonData = py.weather.get_current_weather("Paris","France",apikey.Key)
```

```
jsonData =
  Python dict with no properties.

    {'coord': {'lon': 2.35, 'lat': 48.85}, 'weather': [{'id': 803, 'main': 'Cloud
```

```
def get_current_weather(city, country, apikey):
    # get current conditions in specified location
    # get_current_weather('boston','us',key)
    import urllib.request
    import json
    # read current conditions
    try:
        url = "https://api.openweathermap.org/data/2.5/weather?q="+city+","+country+"&appid="+apikey
        response = urllib.request.urlopen(url)
        html = response.read()
        json_data = json.loads(html)

    except urllib.error.URLError:
        # if weather API doesnt work, read the file
        json_data = read_backup(city)

    return json_data
```

Parse the json data returned from the weather API.

The Python dictionary can be represented as a MATLAB struct.

```
weatherData = py.weather.parse_json(jsondata);
struct(weatherData)
```

```
ans = struct with fields:
            temp: 18.7100
      feels_like: 17.3000
        temp_min: 17.7800
        temp_max: [1×1 py.int]
```

Use a function (`prepData.m`) to prepare data for machine learning (create a table with the expected variable names, preprocessing steps, etc).

```
currentData = prepData(weatherData)
```

currentData = 1×12 table

	DateLocal	city	StateName	T	P	DP	RH	WindDir	WindSpd
1	01-Jul-2020 11:...	"Paris"	Ile de France	21.6200	20.2600	349.2200	1010	5.1000	73

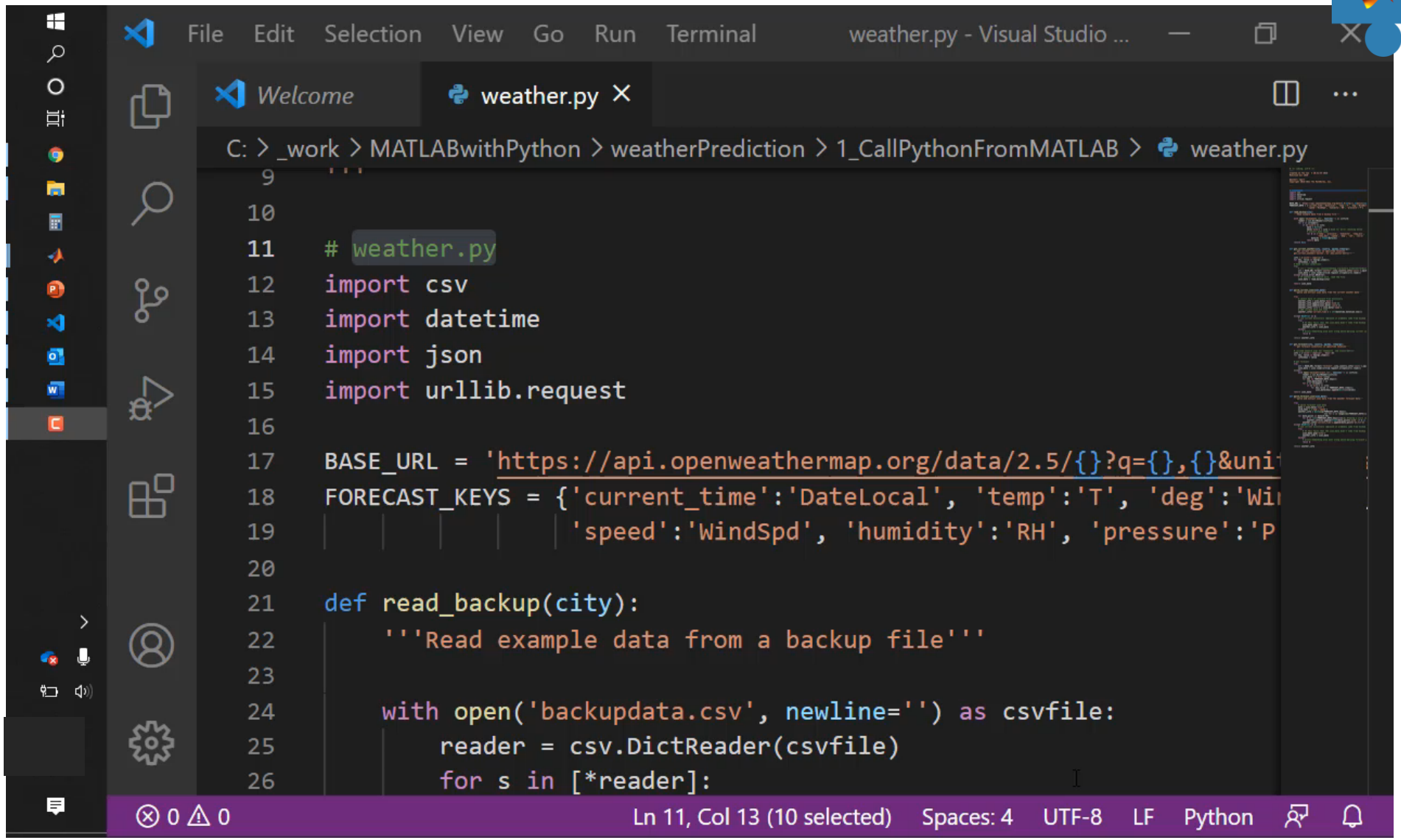
Calling Python libraries from MATLAB

Data Access

Co-Execution

- Call Python from MATLAB
- Call MATLAB from Python

Deployment



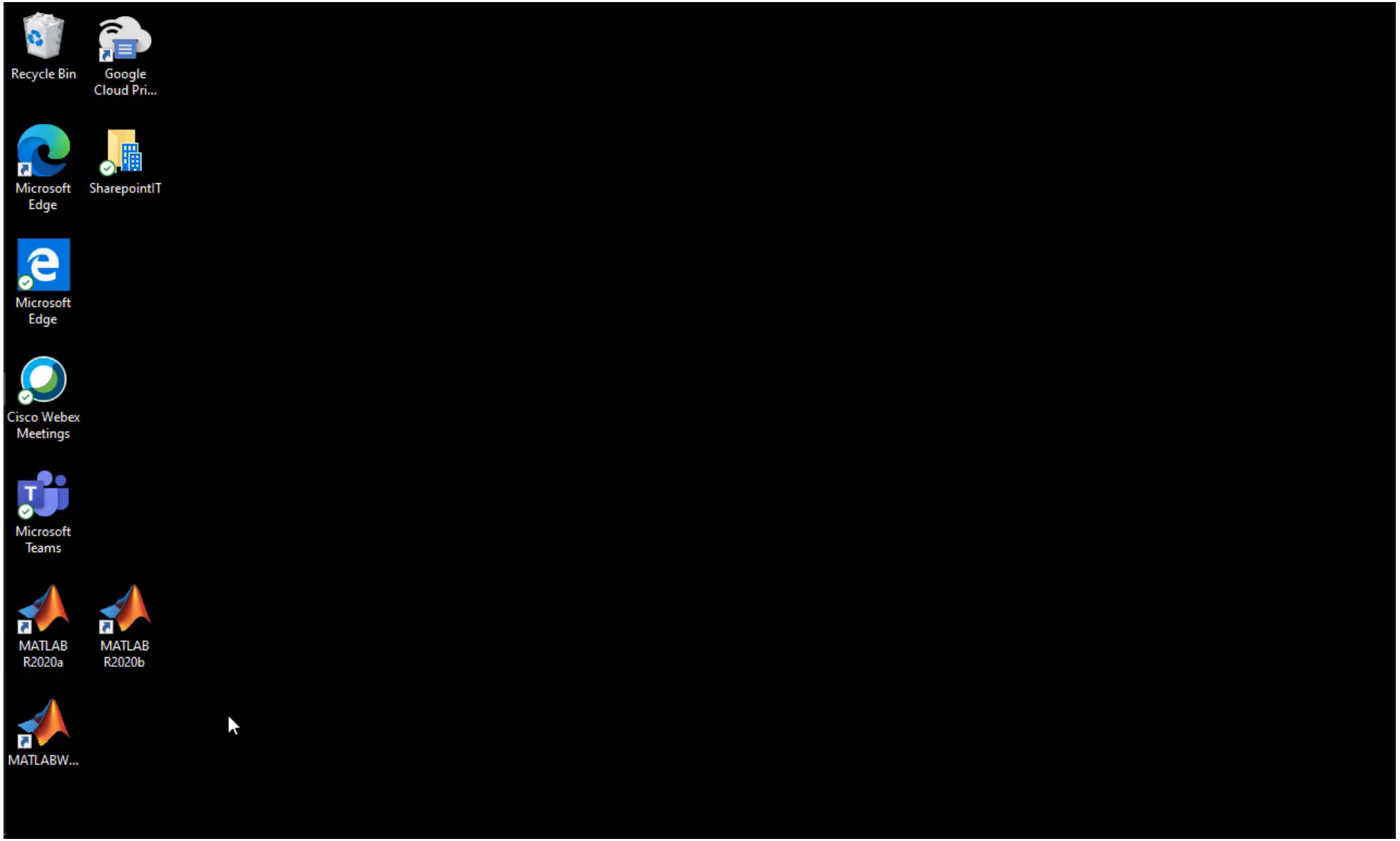
Connect to Python

Data Access

Co-Execution

- Call Python from MATLAB
- Call MATLAB from Python

Deployment

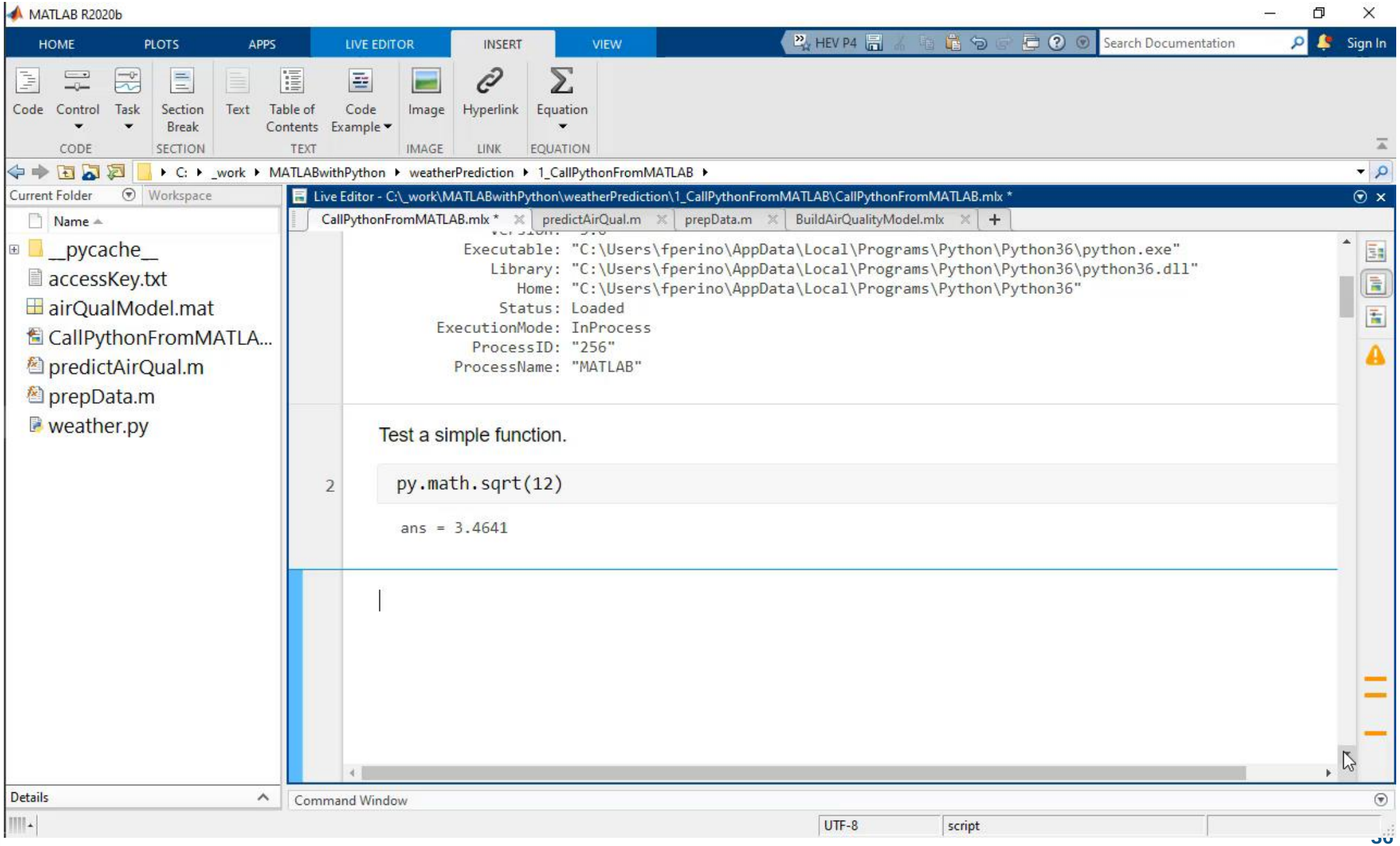


Data Access

Co-Execution

- Call Python from MATLAB
- Call MATLAB from Python

Deployment



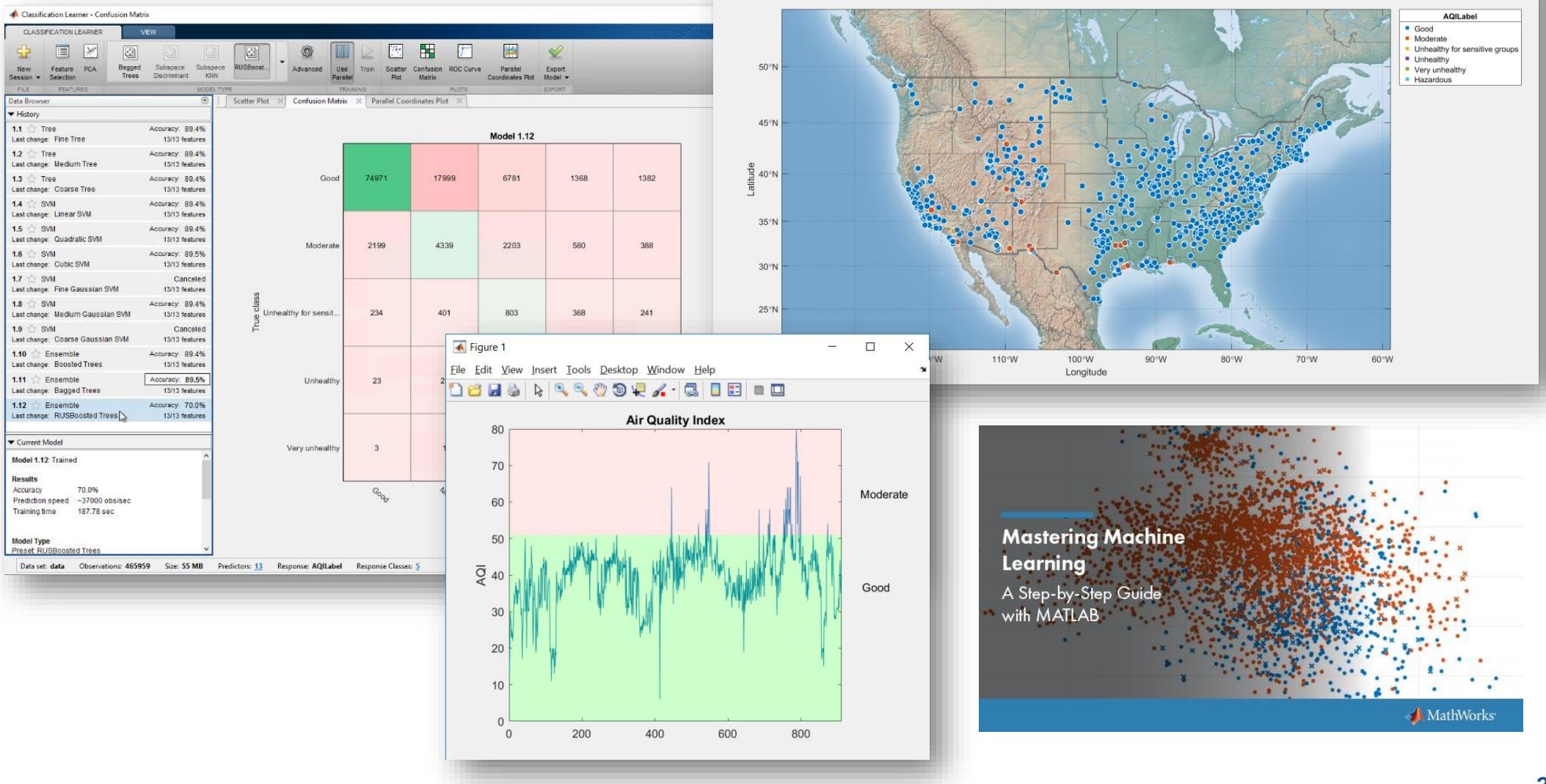
Air Quality Prediction Model

Data Access

Co-Execution

- Call Python from MATLAB
- Call MATLAB from Python

Deployment



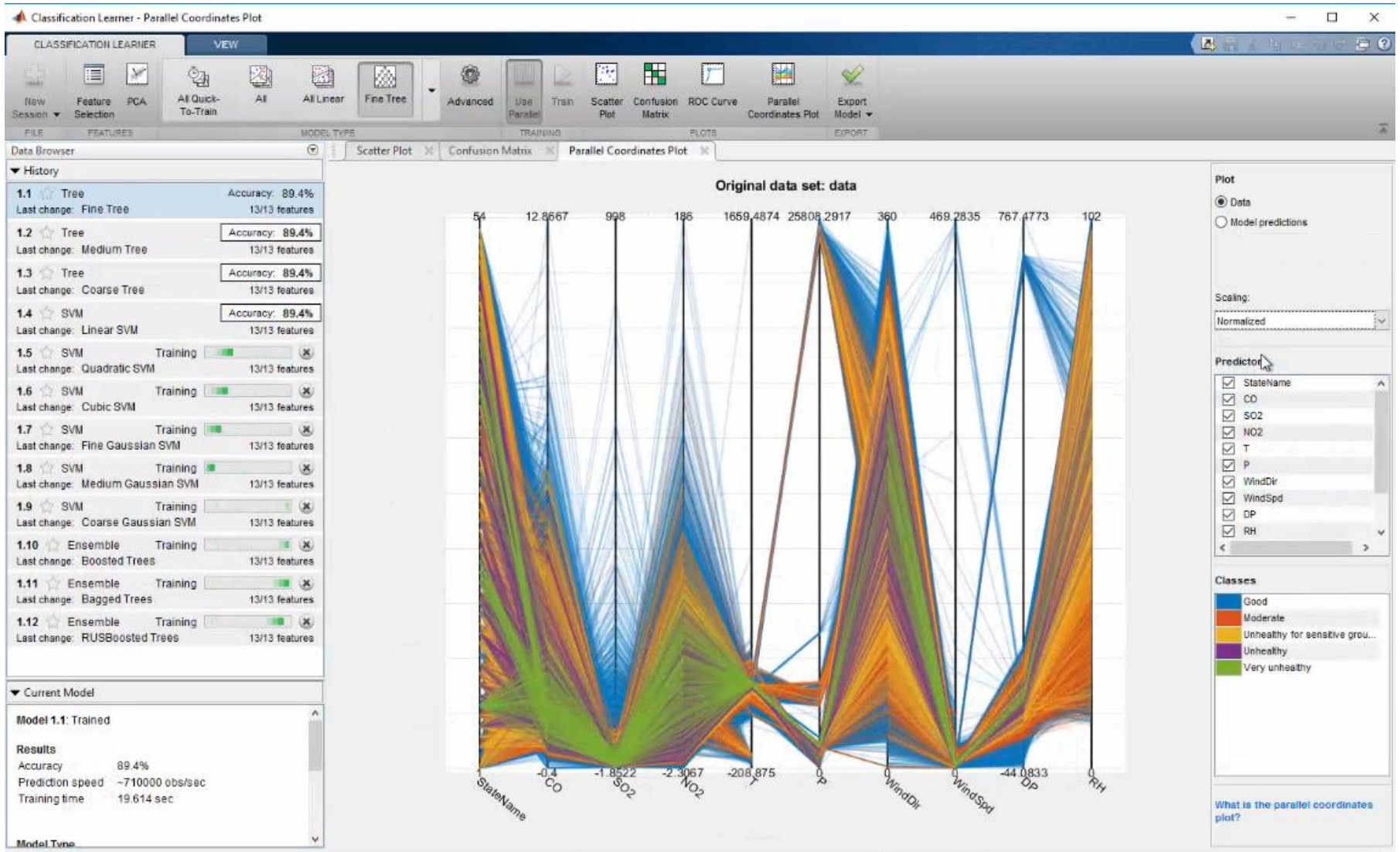
Train the Air Quality Prediction Model

Data Access

Co-Execution

- Call Python from MATLAB
- Call MATLAB from Python

Deployment



Model development is illustrated in Heather's webinar [MATLAB with Data Science]

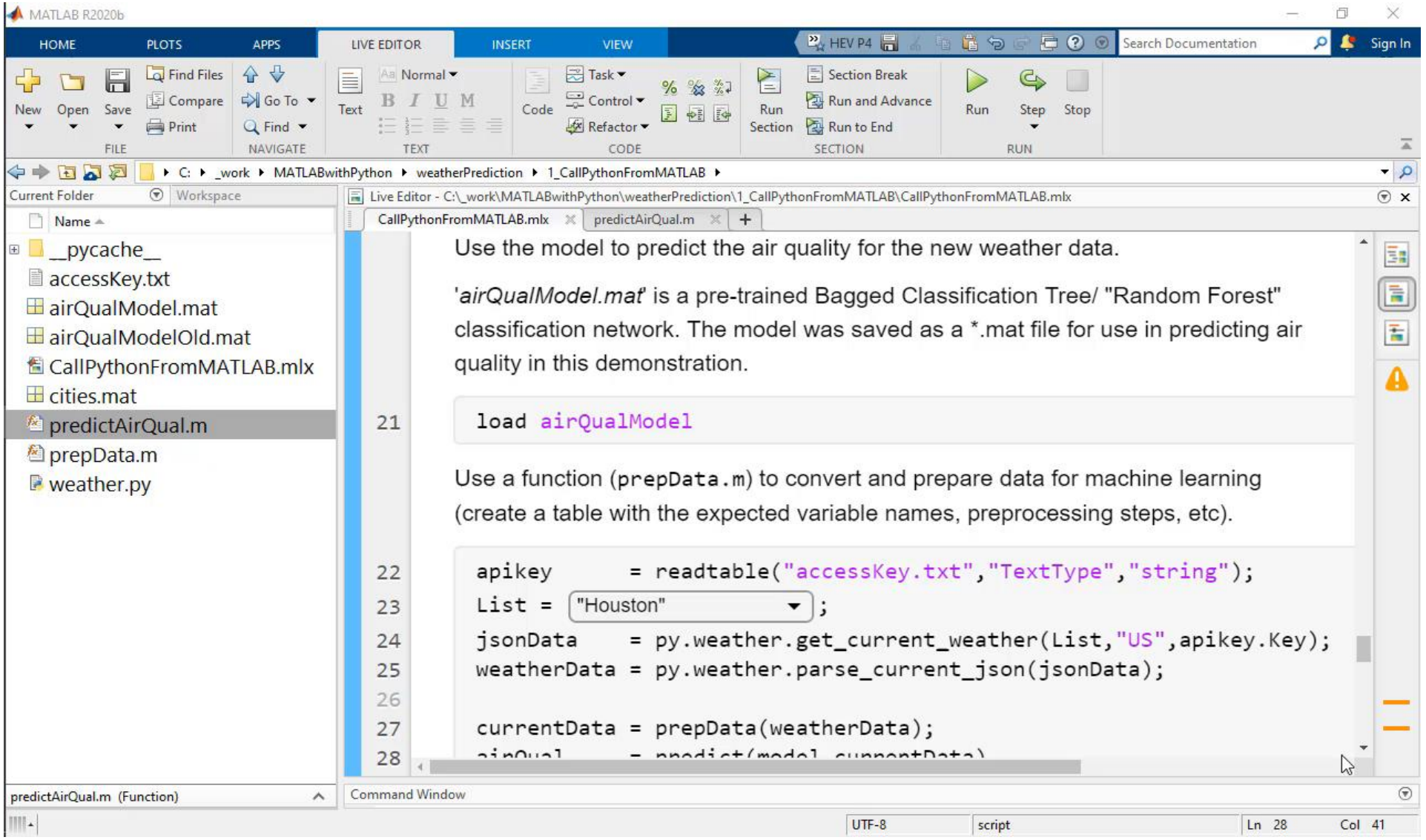
Call the Air Quality Prediction Model

Data Access

Co-Execution

- Call Python from MATLAB
- Call MATLAB from Python

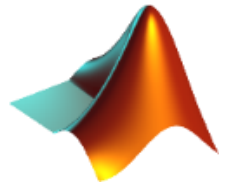
Deployment



Recap: Calling Python from MATLAB

Syntax differences when calling Python from MATLAB

Python



MATLAB

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

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

```
>>> print('hello','world',sep=', ')
```

```
>> py.print('hello','world',...
       pyargs('sep',', '))
```

Data are automatically converted where possible

Otherwise convert explicitly

MATLAB to Python Data Type Mapping

R2021a

When calling a Python® function, MATLAB® converts MATLAB data into types that best represent the data to the Python language.

Pass Scalar Values to Python

MATLAB Input Argument Type — Scalar Values Only	Resulting Python `py.` Type	Examples
`double` `single`	`float`	Use Python Numeric Variables in MATLAB

Complex `single`
Complex `double`
	`complex`	`z = complex(1,2);`
		`py.cmath.polar(z)`
		
		`ans =`
		`Python tuple with no properties.`
		
		`(2.23606797749979, 1.1071487177940904)`

`int8`
`uint8`
`int16`
`uint16`
`int32`
	`int`	

`uint32`
`int64`
`uint64`
	`int`
	`long` (version 2.7 only)	

`NaN`	`float("nan")`	
`Inf`	`float("inf")`	
`string` scalar	`str`	Use Python str Variables in MATLAB

https://mathworks.com/help/matlab/matlab_external/passing-data-to-python.html

Data Access

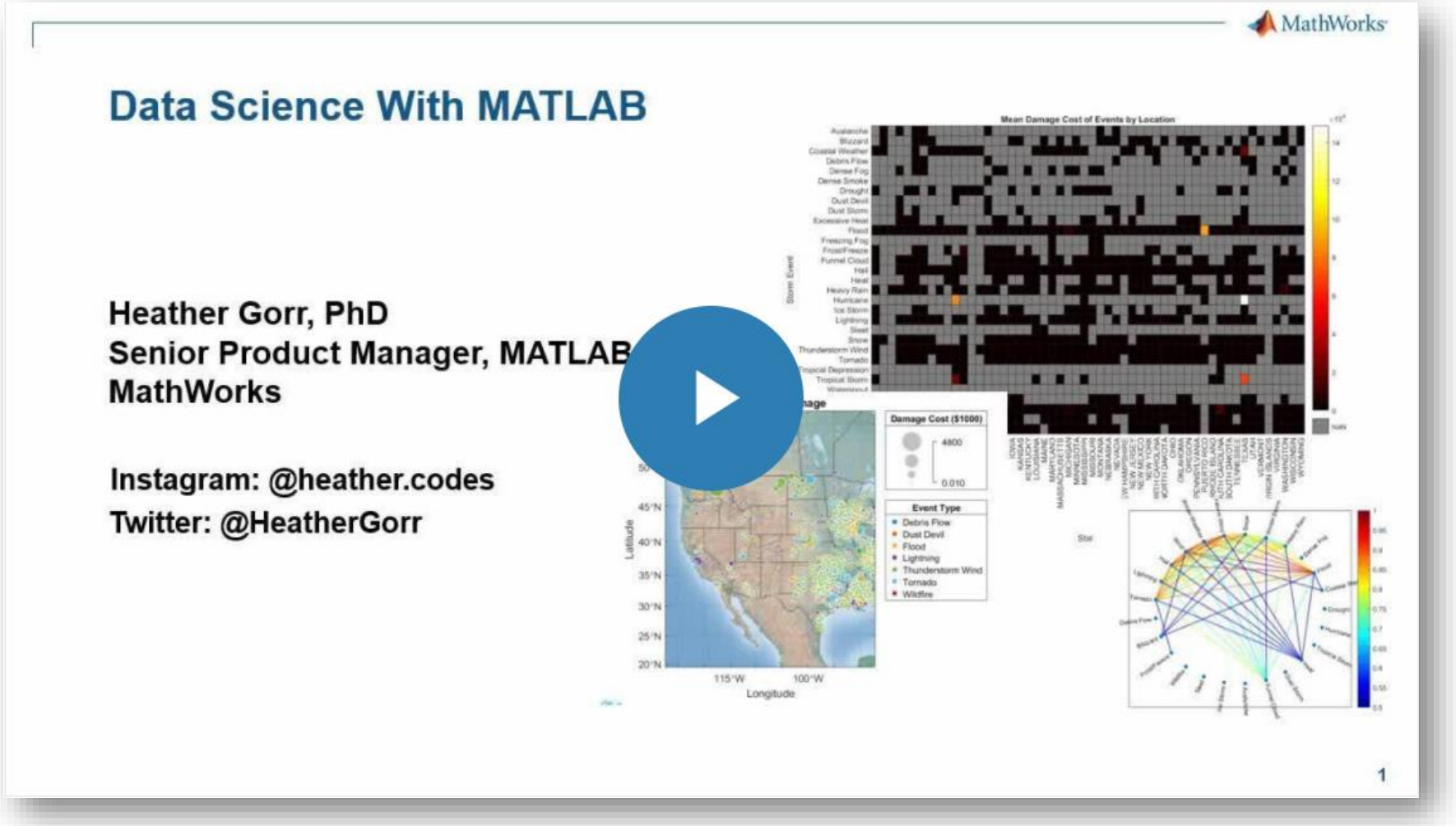
Co-Execution

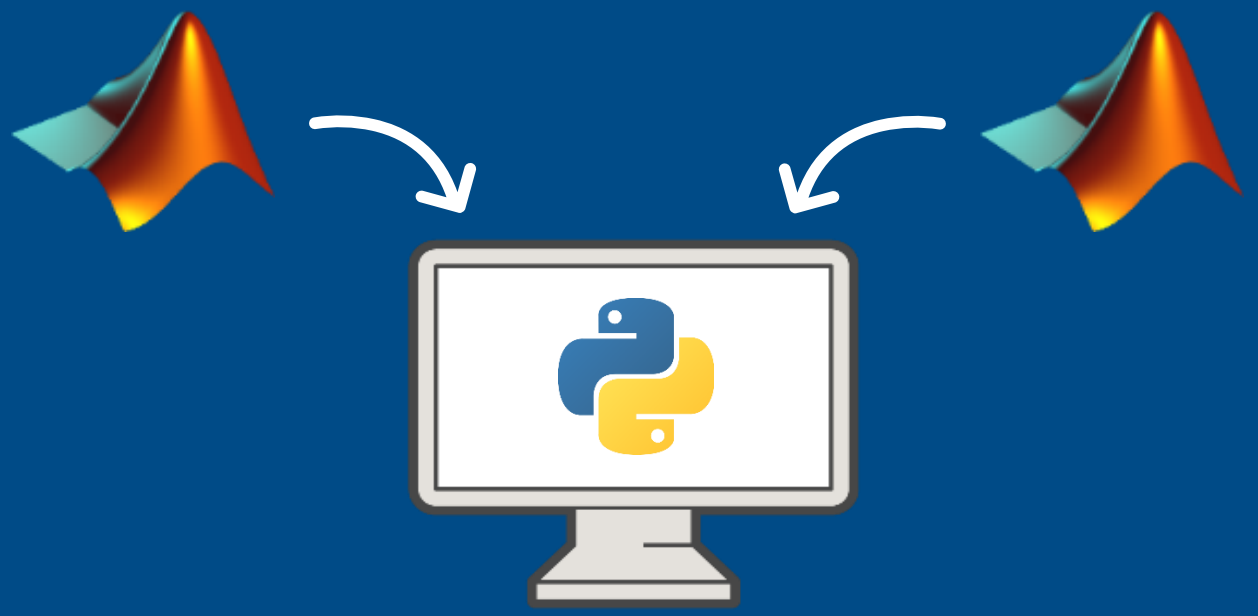
- Call Python from MATLAB
- Call MATLAB from Python

Deployment

Learn more about

Data Science with MATLAB



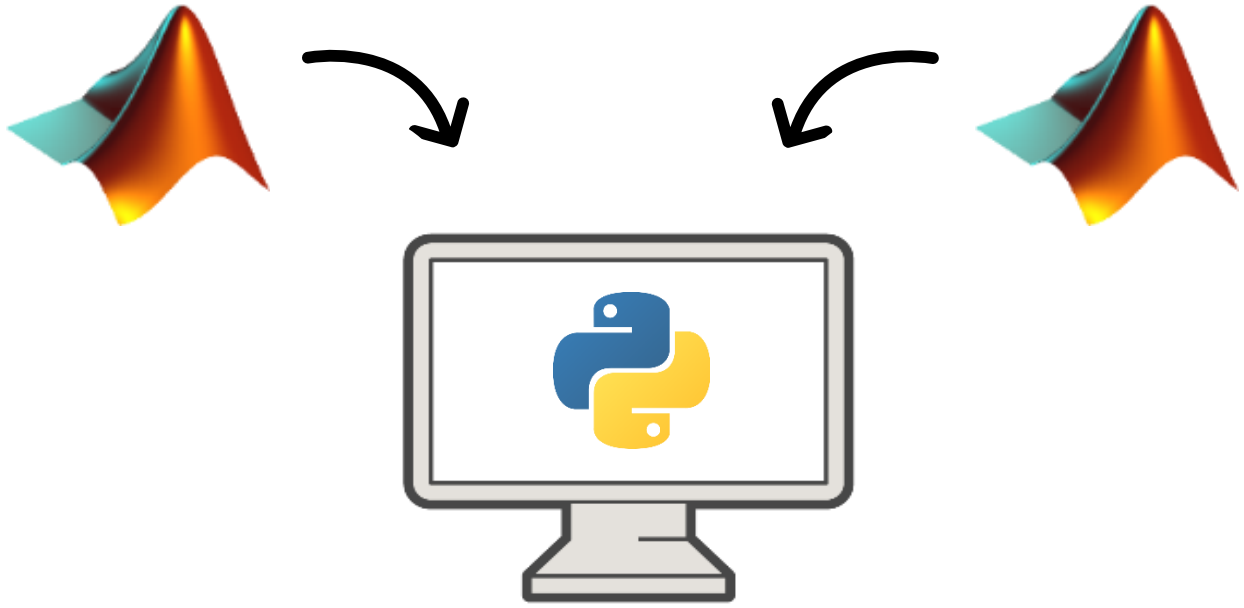


Call MATLAB from Python

Why call MATLAB from Python?

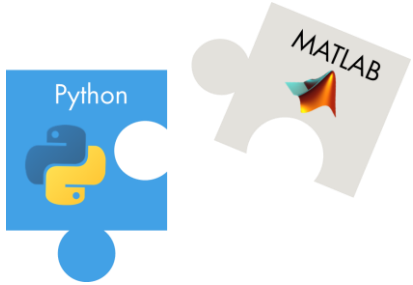
Already working in Python, and:

- Want to reuse existing MATLAB code
- Need functionality available in MATLAB
- Want to collaborate with MATLAB users



Call MATLAB from Python

MATLAB Engine API



- Install MATLAB Engine API for Python

```
$ cd "C:\Program Files\MATLAB\R2021b\extern\engines\python“
$ python setup.py install
```

- Start a MATLAB process

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

- Call MATLAB functions

```
>>> x = m.sqrt(float(42))
```

Integrate the MATLAB model in a Python environment

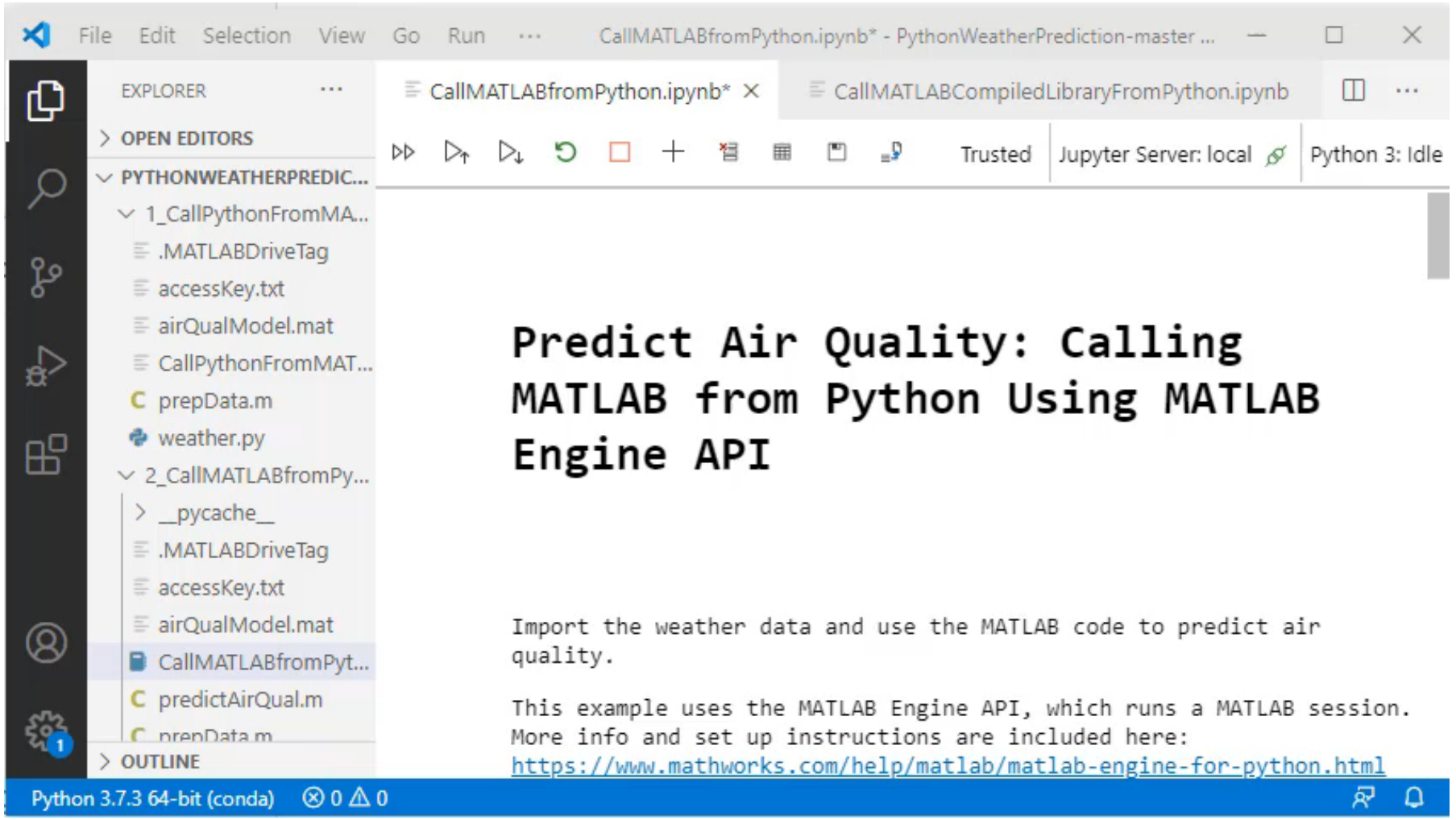
CallMATLABfromPython.ipynb

Data Access

Co-Execution

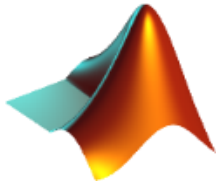
- Call Python from MATLAB
- **Call MATLAB from Python**

Deployment



Recap: Calling MATLAB from Python

Syntax differences when calling MATLAB from Python



MATLAB

Python

```
>> [s,sidx] = sort(x)
```

→

```
>>> s = eng.sort(x,nargout=2)
```

```
>> foo(x)
```

```
>>> eng.foo(x,nargout=0)
```

```
>> C = A + B
```

→

```
>>> C = eng.plus(A,B)
```

Data are automatically converted where possible

Data Access

Co-Execution

- Call Python from MATLAB
- **Call MATLAB from Python**

Deployment

Pass Data to MATLAB from Python

R2021a

Python Type to MATLAB Scalar Type Mapping

When you pass Python® data as input arguments to MATLAB® functions, the MATLAB Engine for Python converts the data into equivalent MATLAB data types.

Python Input Argument Type — Scalar Values Only	Resulting MATLAB Data Type
`float`	`double`
`complex`	Complex `double`
`int`	`int64`
`long` (Python 2.7 only)	`int64`
`float(nan)`	`NaN`
`float(inf)`	`Inf`
`bool`	`logical`
`str`	`char`
`unicode` (Python 2.7 only)	`char`
`dict`	Structure if all keys are strings not supported otherwise

Python Container to MATLAB Array Type Mapping

Python Input Argument Type — Container	Resulting MATLAB Data Type
`matlab` numeric array object (see MATLAB Arrays as Python Variables)	Numeric array
`bytearray`	`uint8` array
`bytes` (Python 3.x) `bytes` (Python 2.7)	`uint8` array `char` array
`list`	Cell array
`set`	Cell array
`tuple`	Cell array

https://mathworks.com/help/matlab/matlab_external/pass-data-to-matlab-from-python.html

Deployment

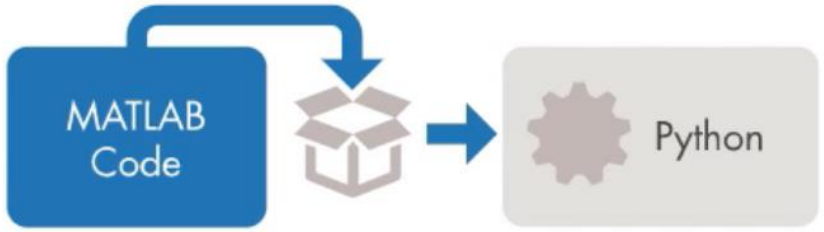
Generate Python library from MATLAB functions

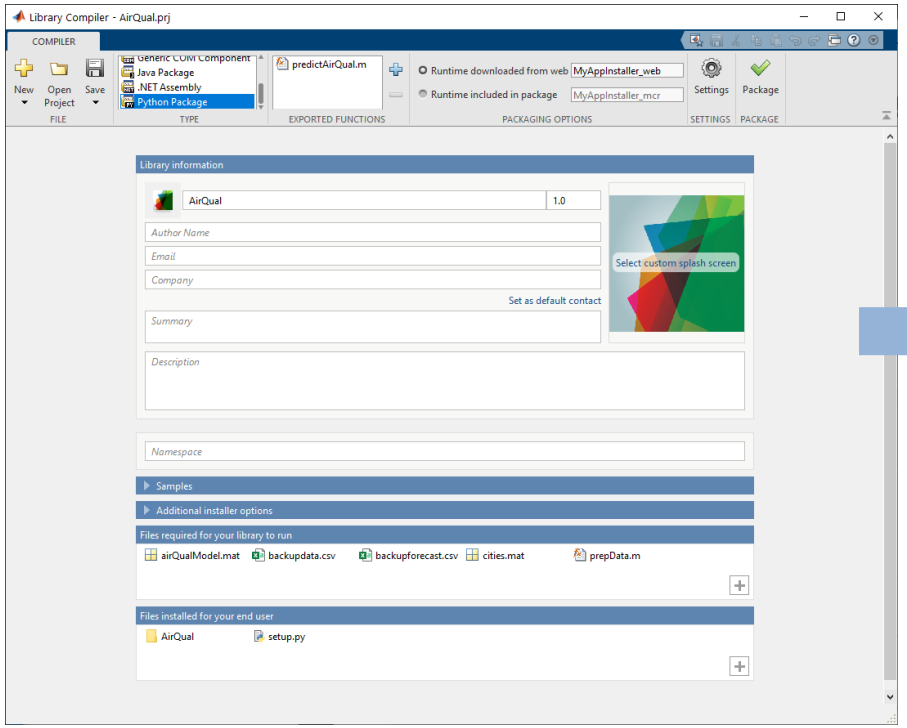
Data Access

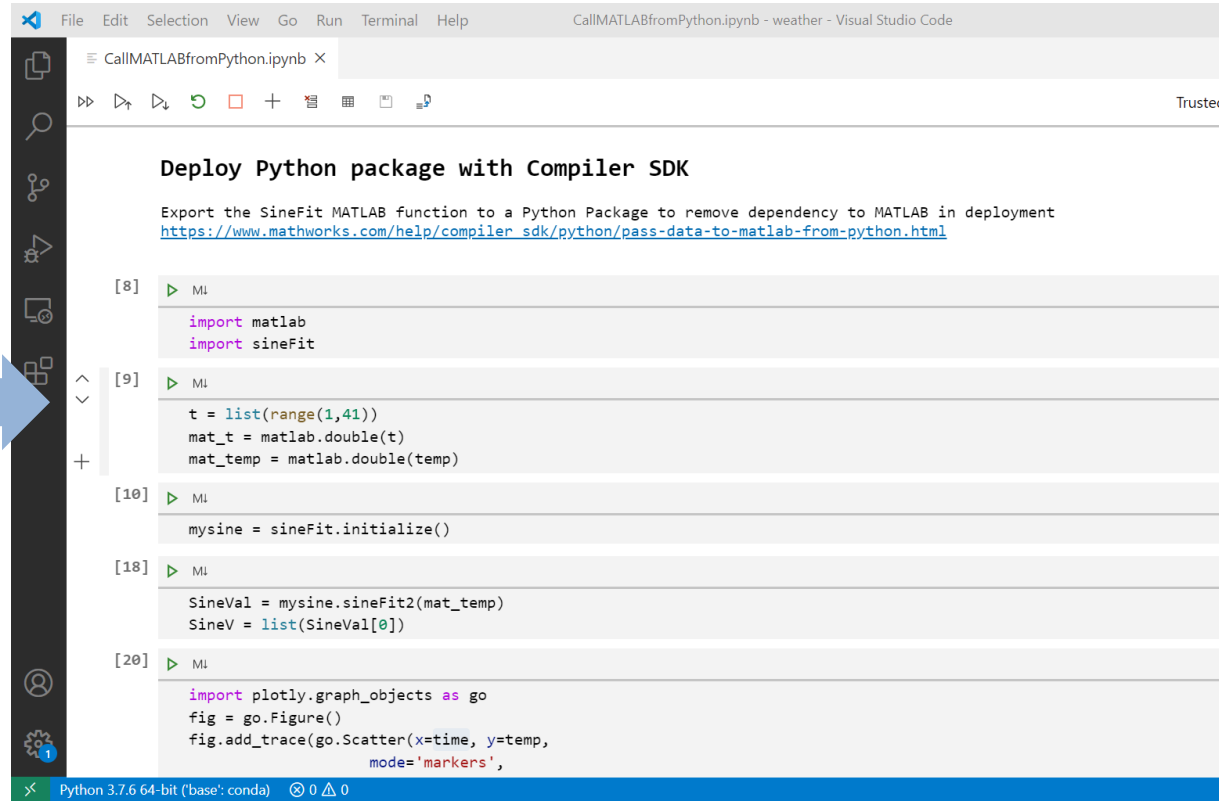
Co-Execution

- Call Python from MATLAB
- Call MATLAB from Python

Deployment







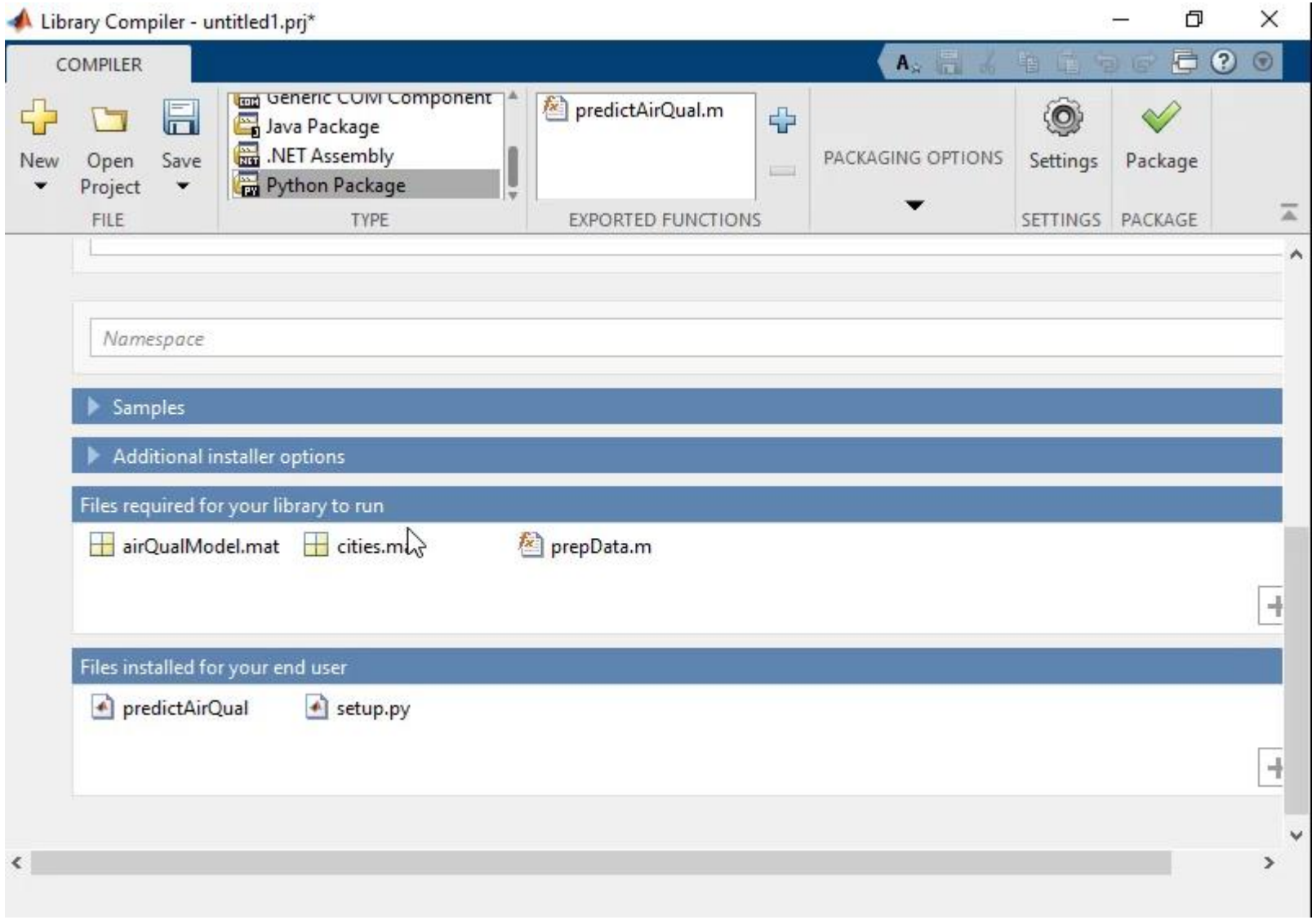
Data Access

Co-Execution

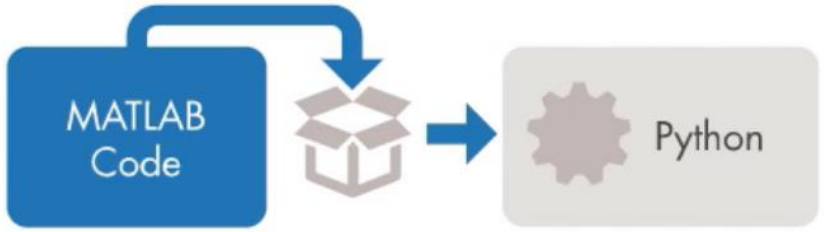
- Call Python from MATLAB
- Call MATLAB from Python

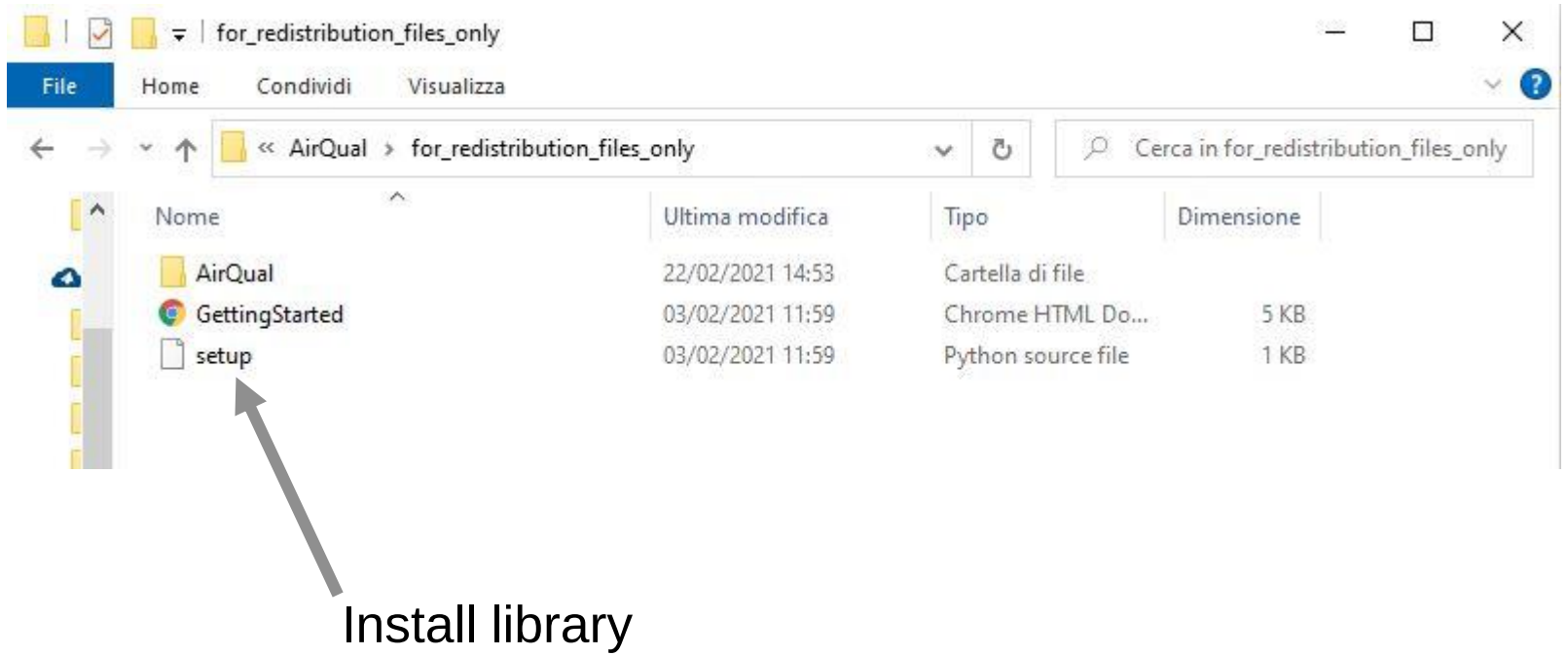
Deployment

Generate Python library from MATLAB functions



Generate Python library from MATLAB functions





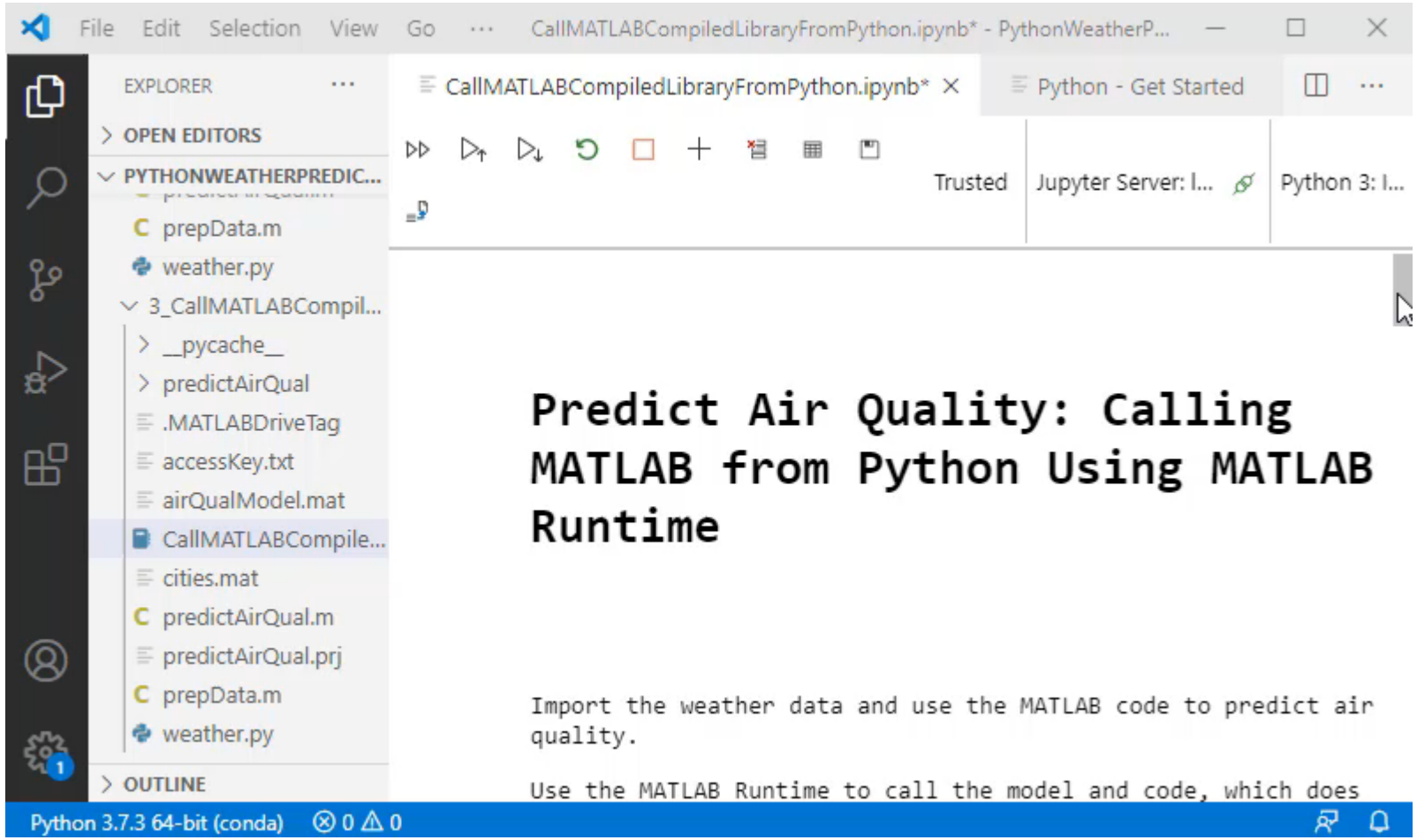
Execute Python library from MATLAB functions

Data Access

Co-Execution

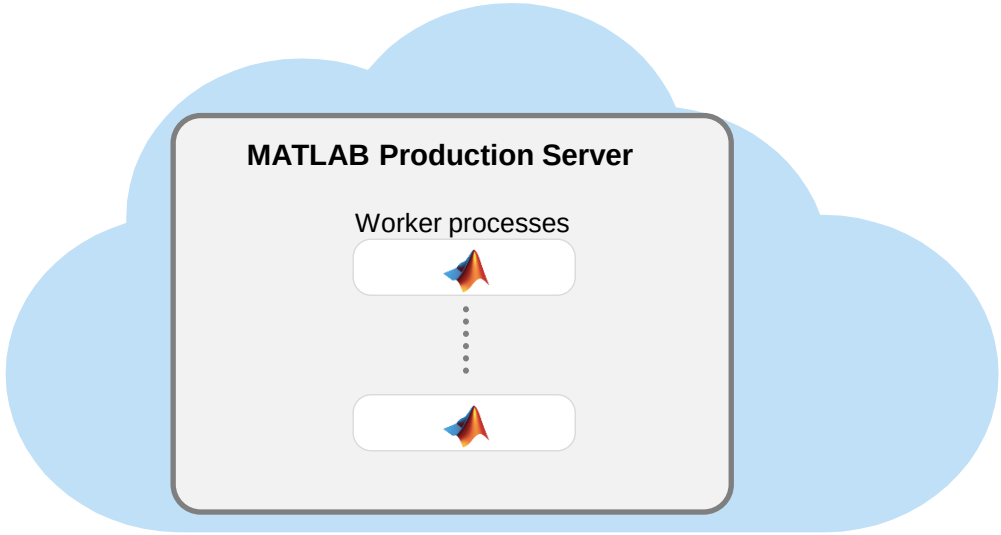
- Call Python from MATLAB
- Call MATLAB from Python

Deployment



MATLAB Production Server

Access functions as web services



Calling our function:

```
{"nargout":1,"rhs":["input"]}
```

Getting the result:

```
{"lhs":[{"mwdata":["output"],"mwsize":[1,6],"mwtype":"char"}]}
```

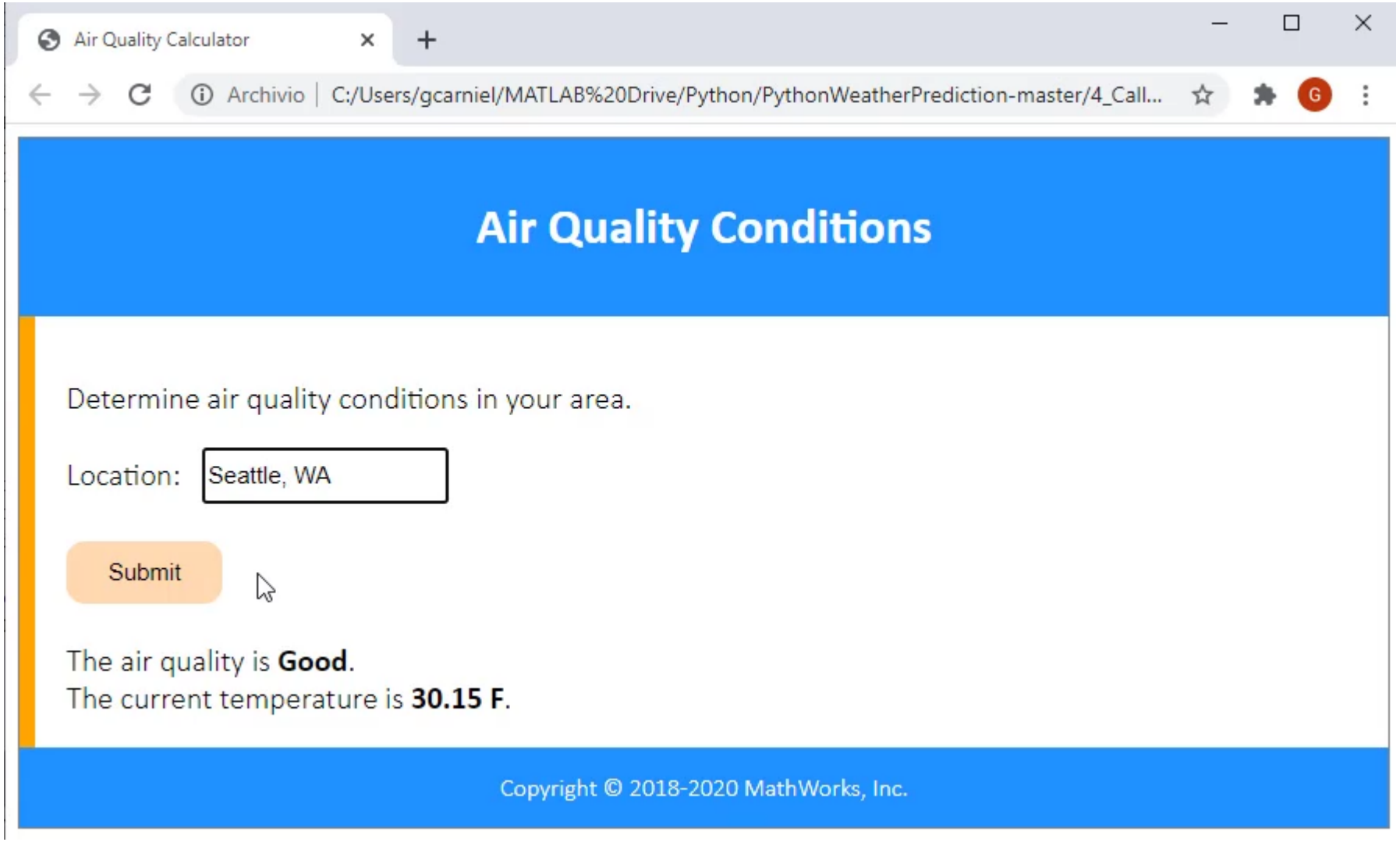
Execute Python library from MATLAB functions

Data Access

Co-Execution

- Call Python from MATLAB
- Call MATLAB from Python

Deployment



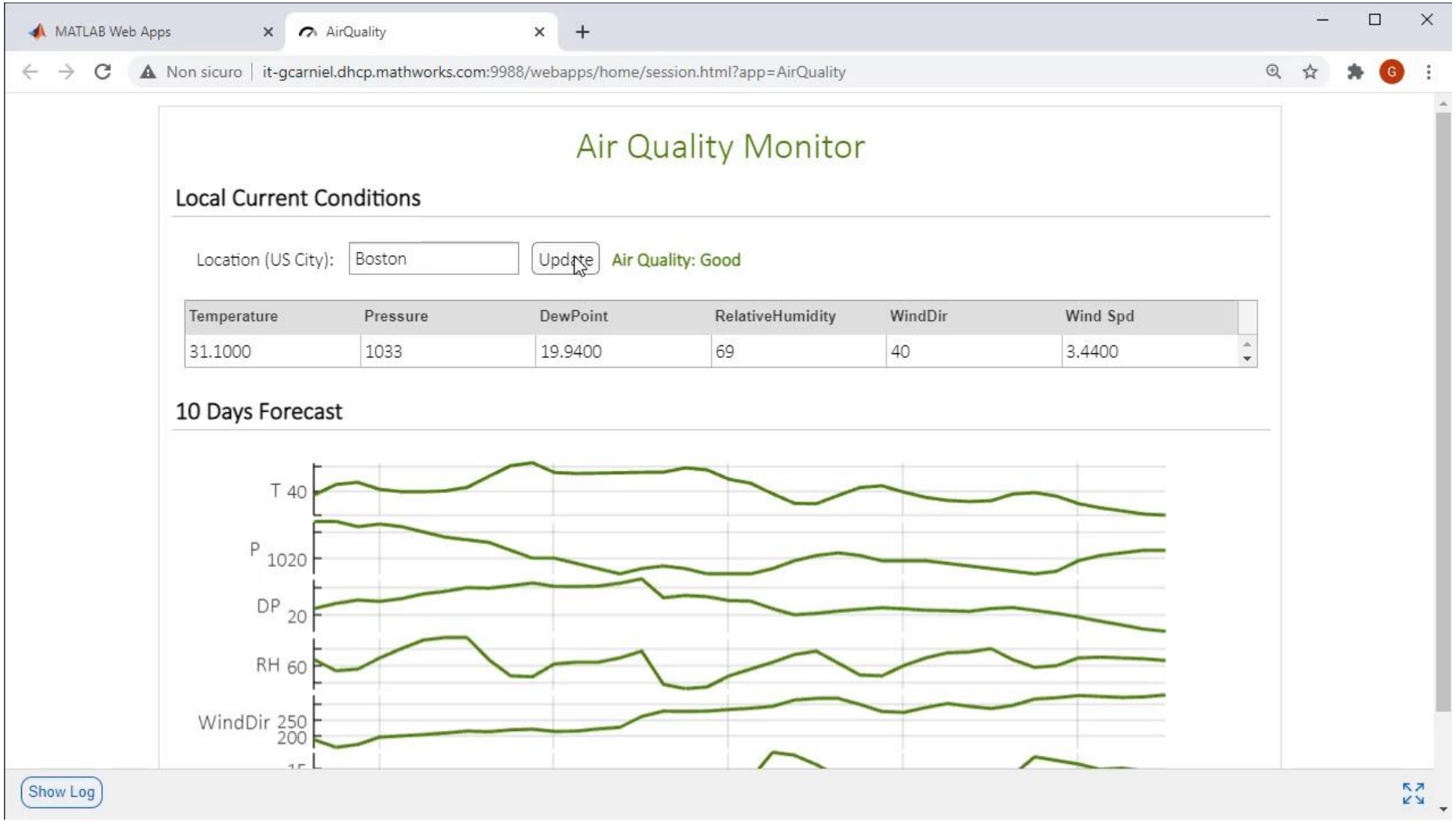
Share MATLAB App in the Web – Central Deployment

Data Access

Co-Execution

- Call Python from MATLAB
- Call MATLAB from Python

Deployment



Data Access

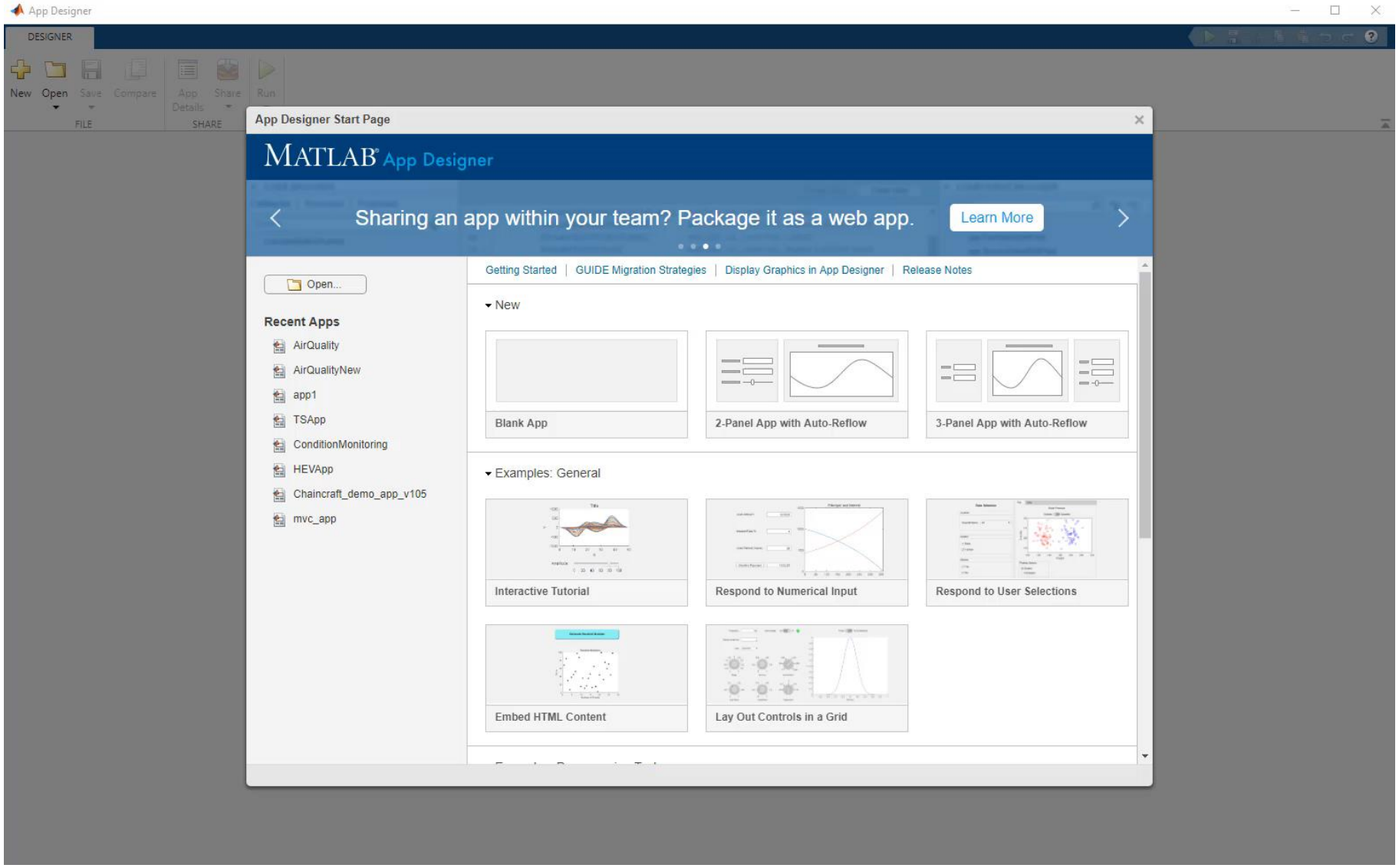
Co-Execution

- Call Python from MATLAB
- Call MATLAB from Python

Deployment

MATLAB App Designer

App development for Non-Programmers



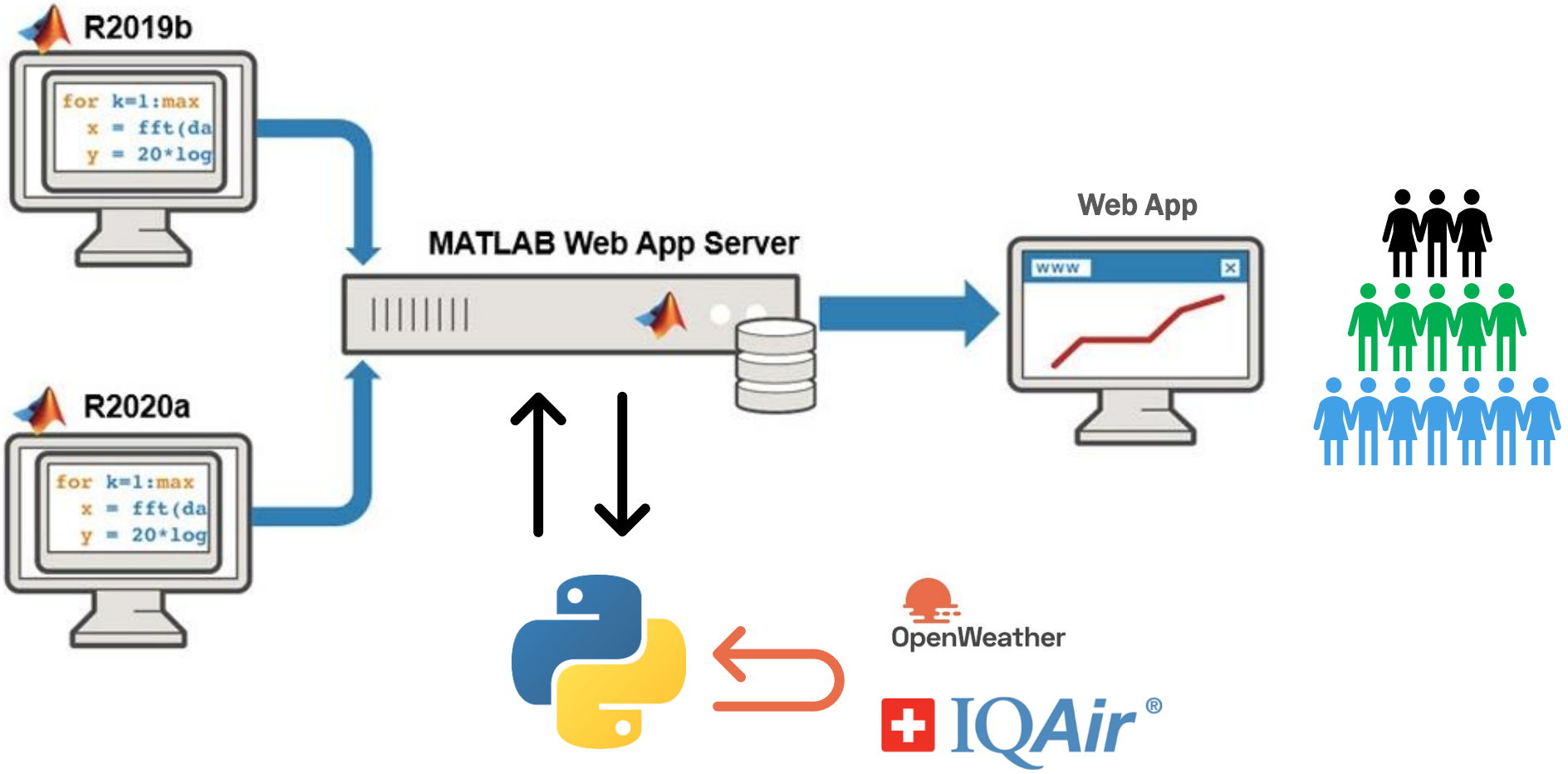
Data Access

Co-Execution

- Call Python from MATLAB
- Call MATLAB from Python

Deployment

MATLAB Web App Server – Central Deployment



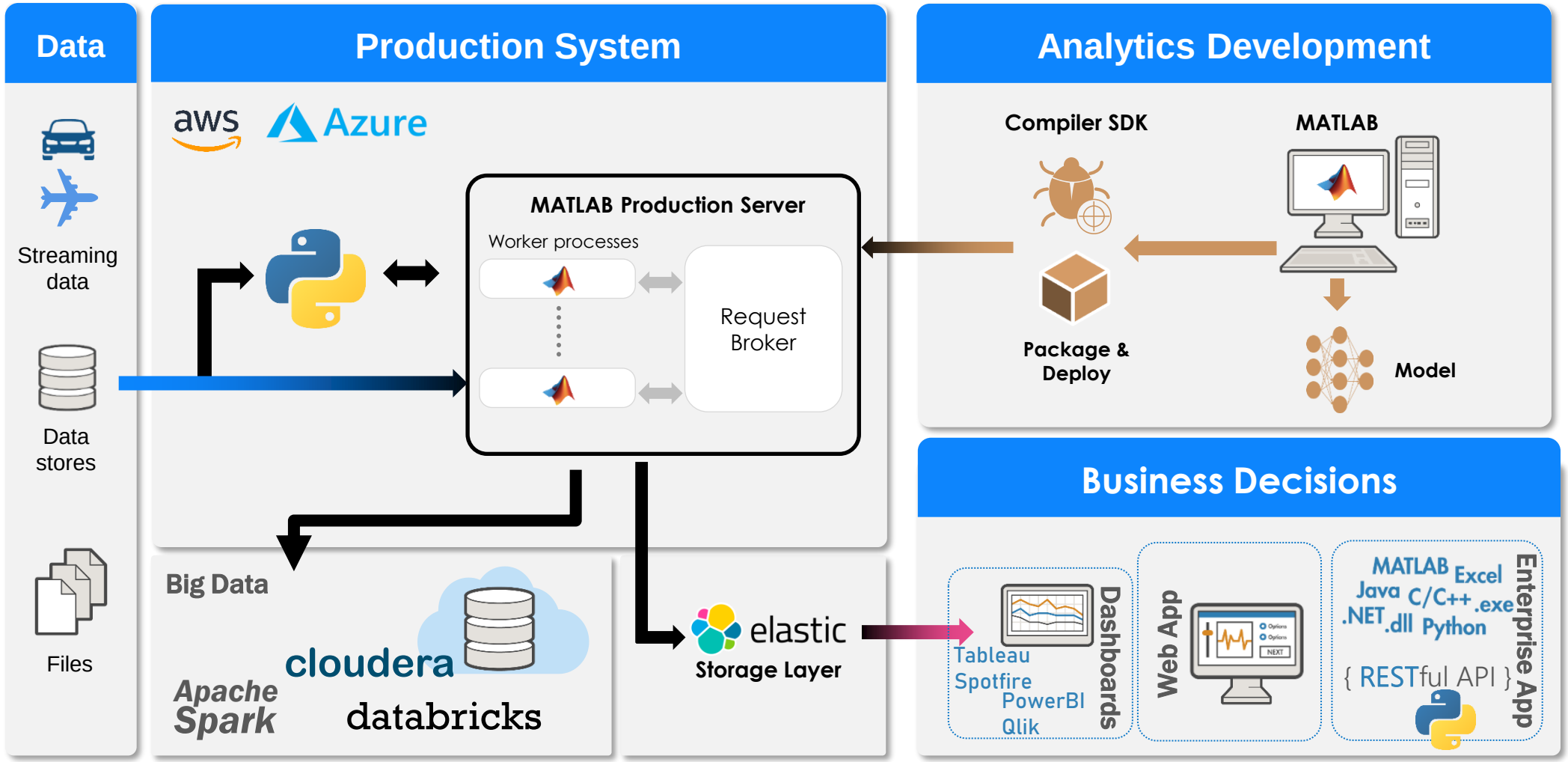
Integrate your Production System in an IT ecosystem

Data Access

Co-Execution

- Call Python from MATLAB
- Call MATLAB from Python

Deployment



Data Access

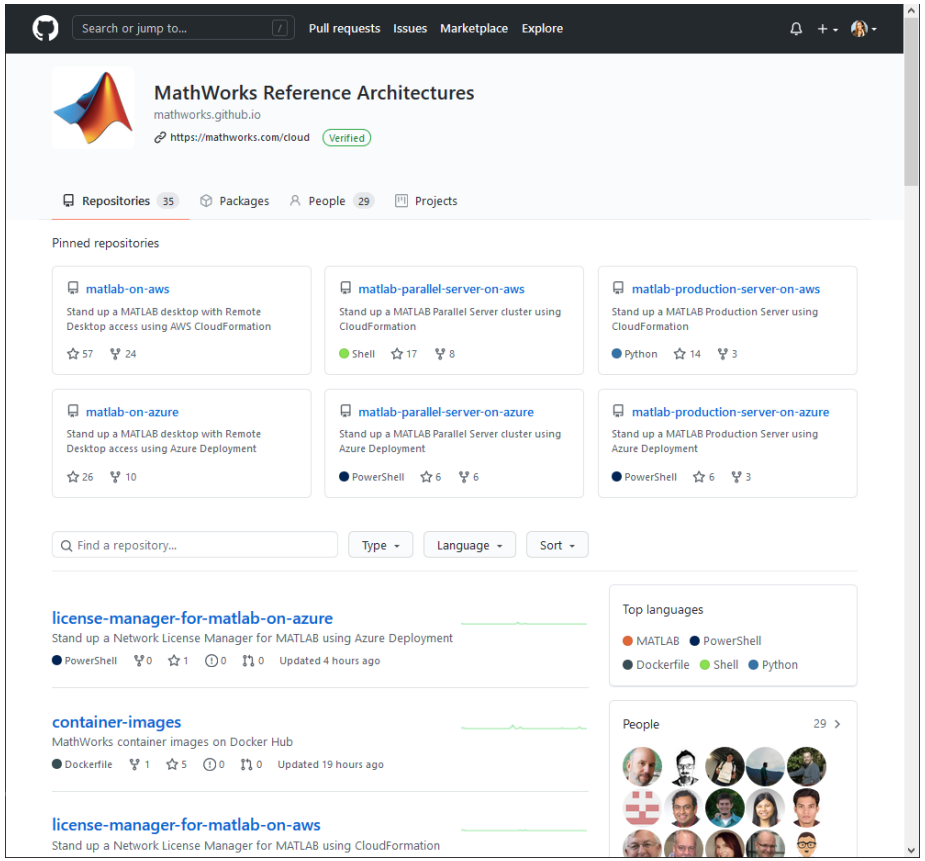
Co-Execution

- Call Python from MATLAB
- Call MATLAB from Python

Deployment

Use MATLAB Reference Architectures for easy cloud setup, Dockerfiles, and interfaces to OSS

- https://github.com/mathworks-ref-arch/matlab-dockerfile



https://github.com/mathworks-ref-arch

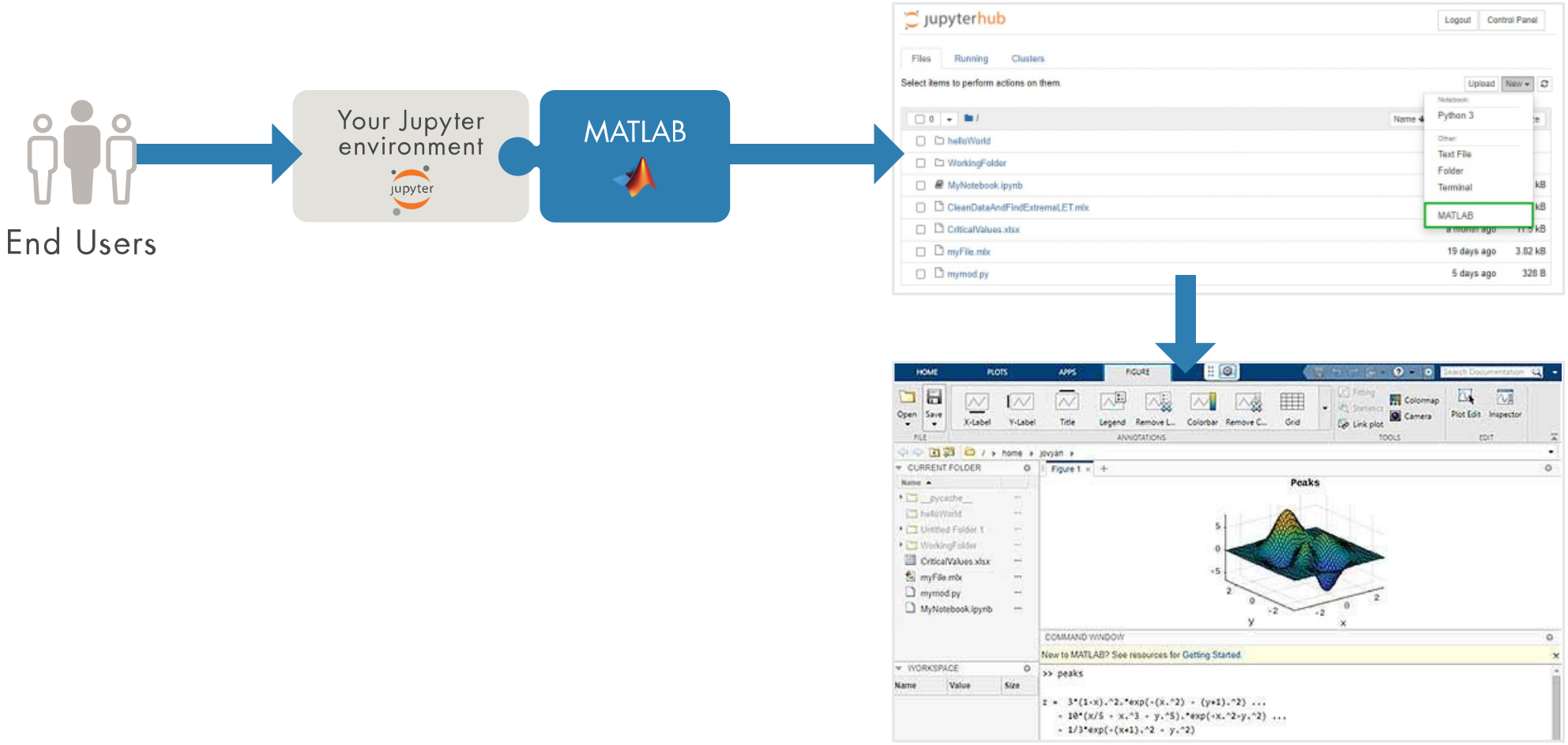
MATLAB Integration for Jupyter

Data Access

Co-Execution

- Call Python from MATLAB
- Call MATLAB from Python

Deployment

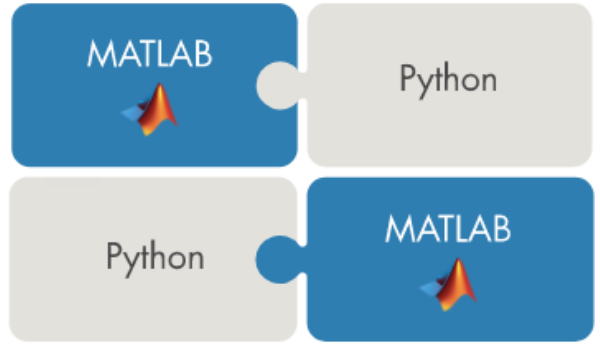


[MATLAB Integration for Jupyter (mathworks.com)]

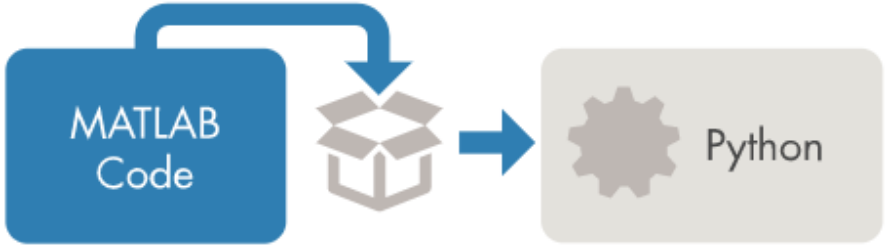
Summary:
Using MATLAB with Python

- Access Data
  - Weather App example

- Interoperability
  - Calling libraries written in Python from MATLAB
  - Calling MATLAB from Python



- Deploy Apps & Algos
  - Web App
  - Production API



Python libraries in MATLAB

Documentation

Python libraries in MATLAB (1)
Directly call Python® functionality from MATLAB®

Using Python Libraries

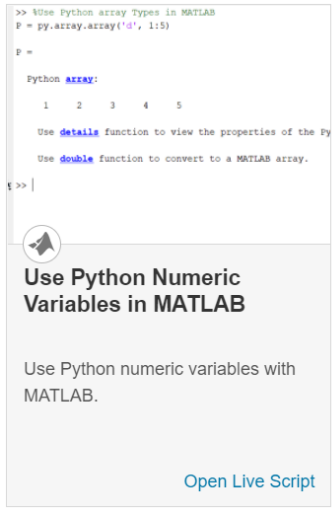
- **Access Python Modules from MATLAB - Getting Started**
  - How to create and use a Python object in MATLAB.
- **Configure Your System to Use Python**
  - How to verify you have installed a supported version of Python.
- **Call User-Defined Python Module**
  - Create a Python module used by examples 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.

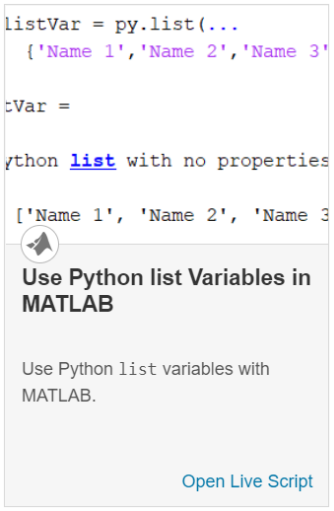
https://www.mathworks.com/help/matlab/call-python-libraries.html

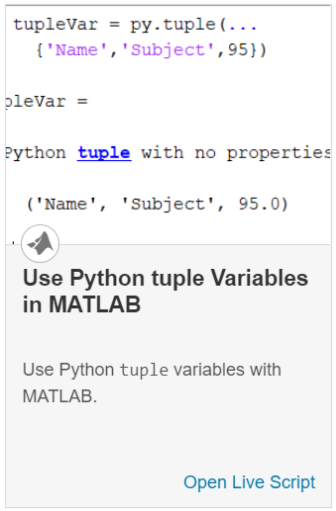
Python libraries in MATLAB (2)
Directly call Python® functionality from MATLAB®

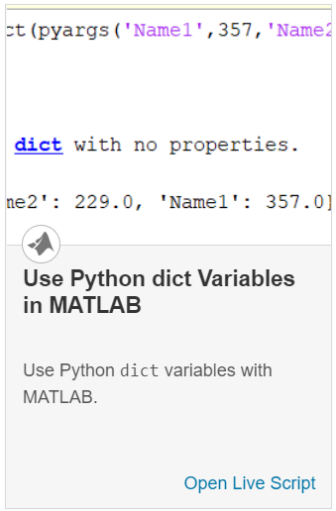
Passing Data

- **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.









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

Cheatsheet

MathWorks®

Accelerating the pace of engineering and science

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)
```

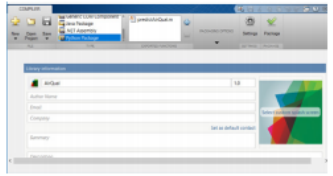
Stop the engine

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

Create Python Package

Package MATLAB functions ≥

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



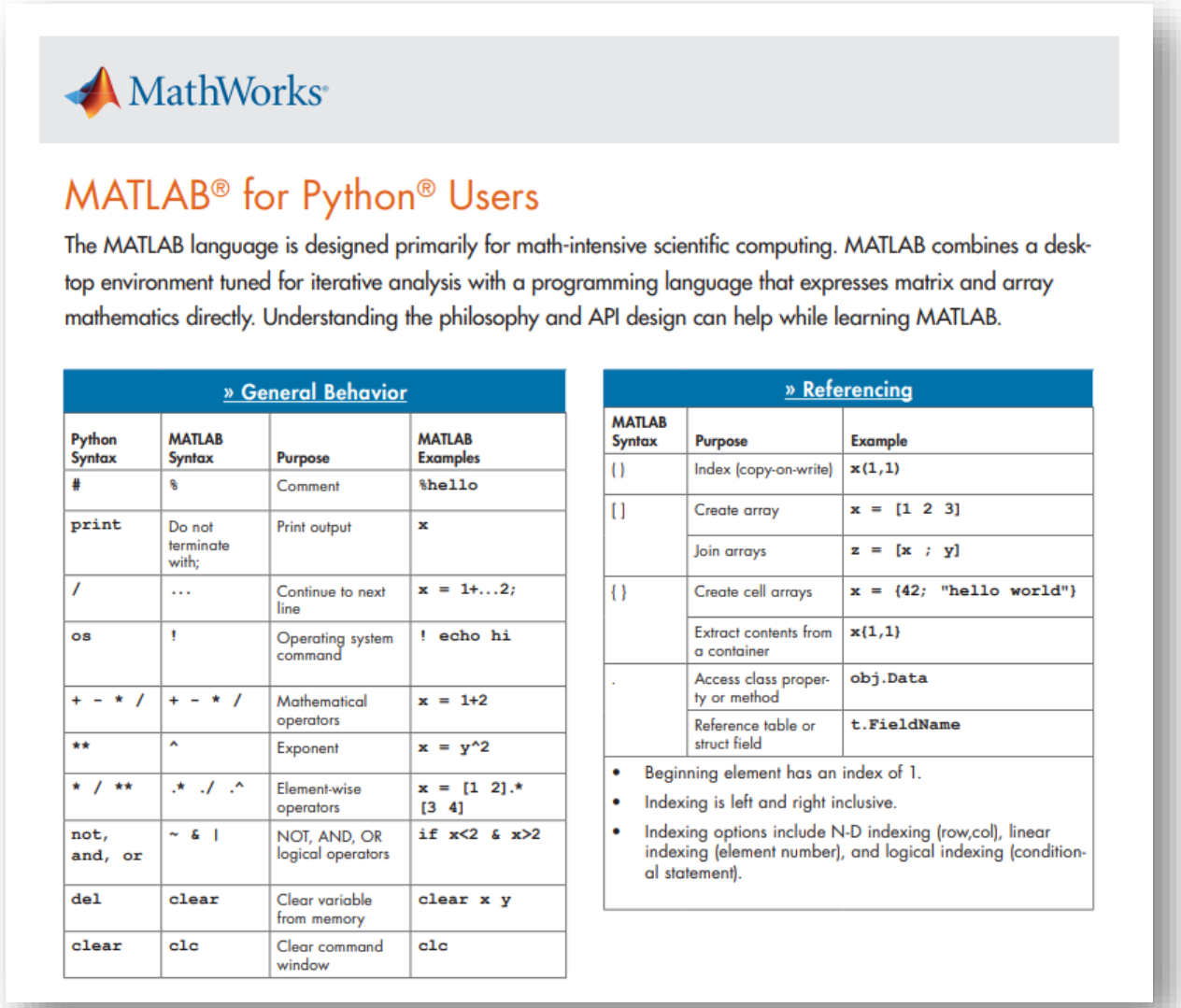
Invoke MATLAB functions from the Python package

```
>>> import PackageName
>>> pkg =
PackageName.initialize()
>>> result = pkg.foo()
```

Close package

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

NEW MATLAB for Python Users Cheat Sheet



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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

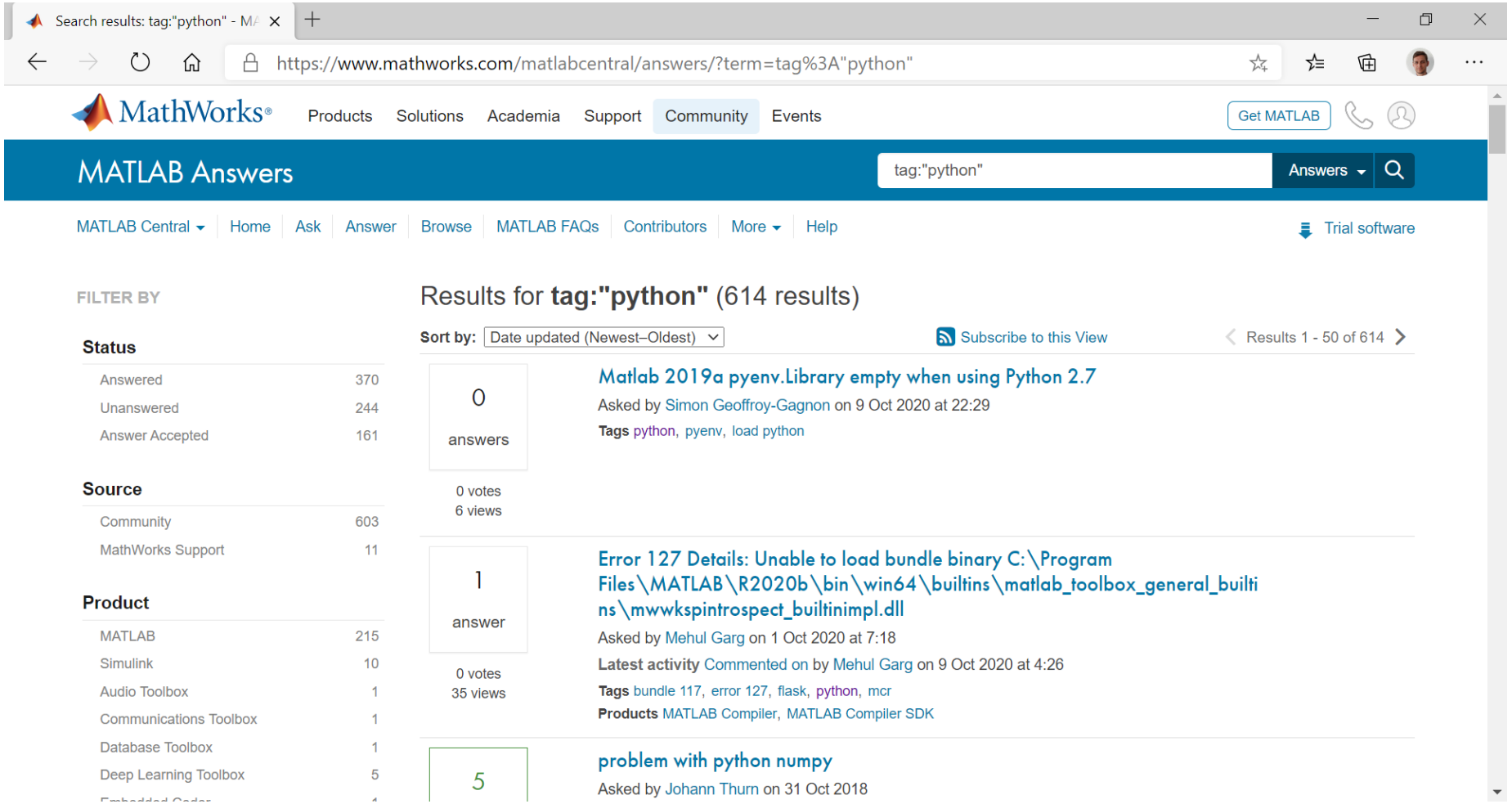
Python Syntax	MATLAB Syntax	Purpose	MATLAB Examples
`#`	`%`	Comment	`%hello`
`print`	Do not terminate with;	Print output	`x`
`/`	`...`	Continue to next line	`x = 1+...2;`
`os`	`!`	Operating system command	`! echo hi`
`+ - * /`	`+ - * /`	Mathematical operators	`x = 1+2`
`**`	`^`	Exponent	`x = y^2`
`* / **`	`.* ./ .^`	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"



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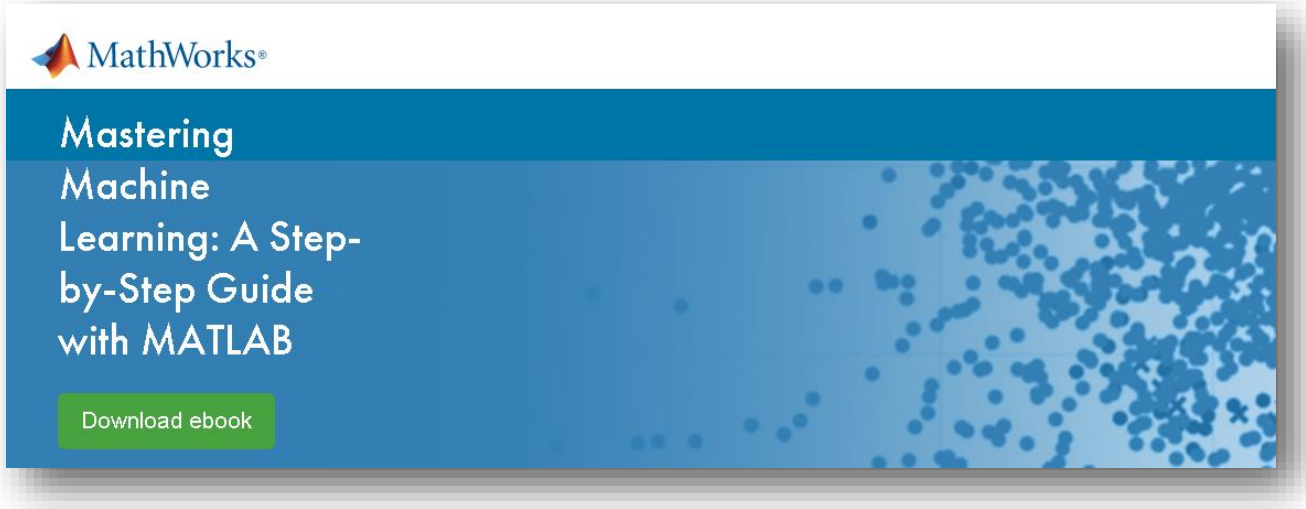

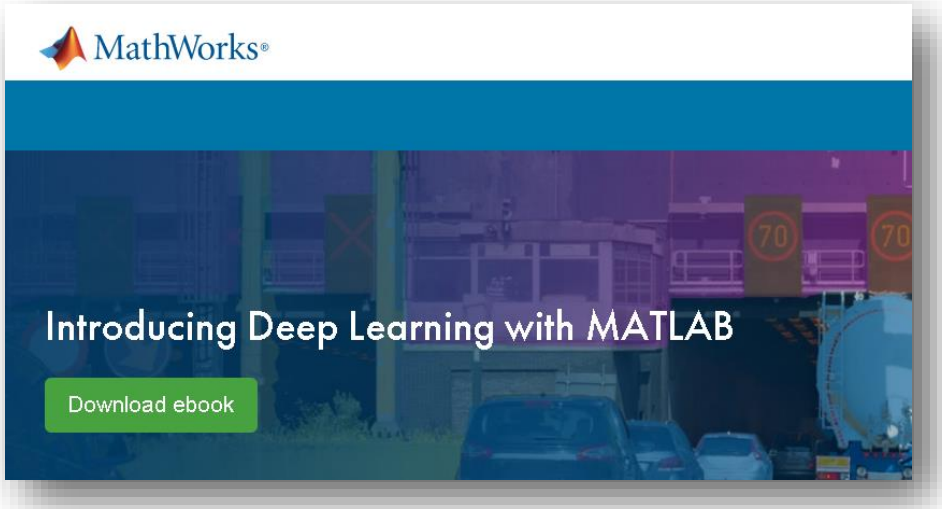

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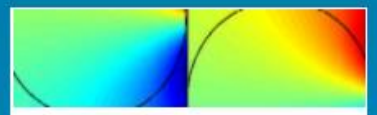

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Deep Learning Onramp

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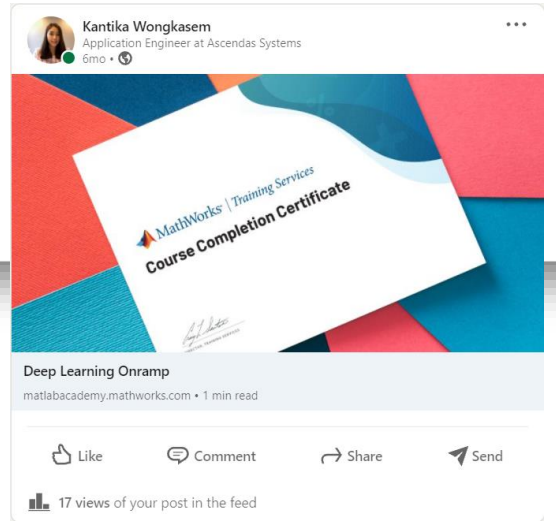
Release: R2020b | Language: English



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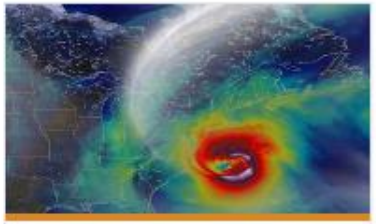

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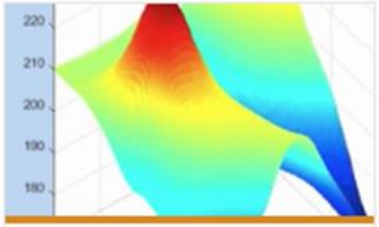

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