



CHHATRAPATI SHAHU JI MAHARAJ UNIVERSITY (CSJMU)

in association with

INDIAN INSTITUTE OF TECHNOLOGY KANPUR (IITK)

organizes



A FIVE DAY NATIONAL WORKSHOP on INTRODUCTION TO MATLAB

Introduction to MATLAB: Empowering researchers and engineers

by

Manas Khan

Department of Physics

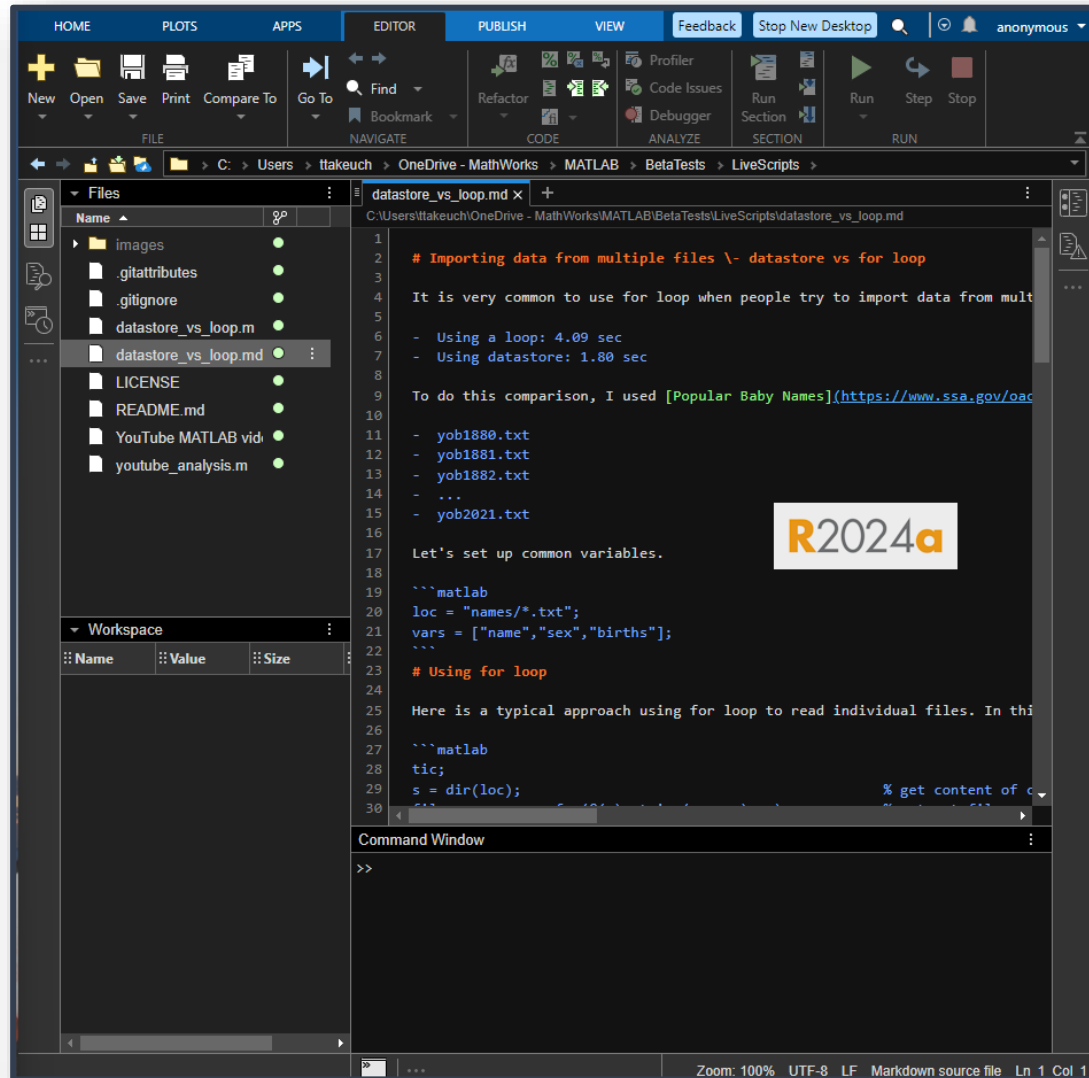
Indian Institute of Technology Kanpur

Date: 8th April, 2025



What is MATLAB?

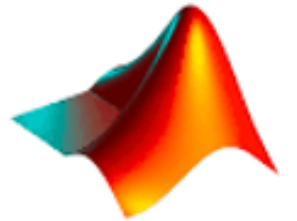
MATLAB (Matrix Laboratory) is a high-performance environment for technical computing, data analysis, and algorithm development



- ✓ User-friendly environment
- ✓ Advanced mathematical functions
- ✓ Powerful visualization tools
- ✓ Specialized toolboxes
- ✓ Integrated Simulink support

Why learn MATLAB?

- ❖ Simplifies complex tasks
- ❖ Accelerates research & development
- ❖ Bridges theory and application
- ❖ Boosts career opportunities



MATLAB Programming Essentials

Conditional statements

```
if x > 0
    disp('Positive')
elseif x < 0
    disp('Negative')
else
    disp('Zero')
end
```

Functions

```
function y = squareNumber(x)
    y = x^2;
end
```

Loops

```
while x < 10
    x = x + 1;
end

for i = 1:5
    disp(i)
end
```

Additional features:

Scripts: Run commands in sequence; share workspace

Vectorized Operations:

- MATLAB is optimized for working with arrays!
- Avoid loops when possible,

- `x = 1:5;`
- `y = x.^2;`

MATLAB for data analysis: From Raw Data to Insights

MATLAB can be used to organize, clean, and analyze complex data sets from diverse fields;

- ❑ Datatypes and preprocessing capabilities designed for engineering and scientific data; import from various sources: `.mat`, `.csv`, `.xlsx`, `.txt`, etc.
- ❑ Excellent prebuilt capabilities for cleaning data, such as **handling missing values, detecting outliers, normalization** etc.
- ❑ Thousands of tools for statistical analysis, machine learning, and signal processing etc.

Import → Clean → Analyze → Save Results

MATLAB's import tool

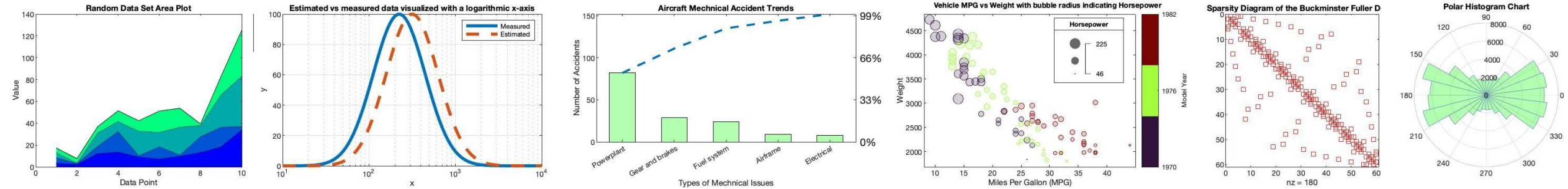
The screenshot displays the MATLAB Import Tool window for a file named 'patients.xls'. The 'IMPORT' tab is active, showing a preview of the data. The 'VIEW' tab is also visible. The 'Range' is set to 'A2:A...', 'Variable Names Row' is '1', and 'Output Type' is 'Table'. The 'Text Options' section is expanded. The 'UNIMPORTABLE CELLS' section shows 'Replace' and 'unimportable cells with NaN'. The 'IMPORT' button is visible on the right. The data preview shows a table with columns: LastName, Gender, Age, Location, Height, Weight, Smoker, Systolic, Diastolic, and SelfAssesse... (Self-Assessment). The data is organized into a table with 27 rows and 10 columns. The first row is the header, and the subsequent rows contain patient data.

	A	B	C	D	E	F	G	H	I	J
	LastName	Gender	Age	Location	Height	Weight	Smoker	Systolic	Diastolic	SelfAssesse...
	Text	Categorical	Number	Categorical	Number	Number	Text	Number	Number	Categorical
1	LastName	Gender	Age	Location	Height	Weight	Smoker	Systolic	Diastolic	SelfAssesse...
2	Smith	Male	38	County Gen...	71	176	1	124	93	Excellent
3	Johnson	Male	43	VA Hospital	69	163	0	109	77	Fair
4	Williams	Female	38	St. Mary's ...	64	131	0	125	83	Good
5	Jones	Female	40	VA Hospital	67	133	0	117	75	Fair
6	Brown	Female	49	County Gen...	64	119	0	122	80	Good
7	Davis	Female	46	St. Mary's ...	68	142	0	121	70	Good
8	Miller	Female	33	VA Hospital	64	142	1	130	88	Good
9	Wilson	Male	40	VA Hospital	68	180	0	115	82	Good
10	Moore	Male	28	St. Mary's ...	68	183	0	115	78	Excellent
11	Taylor	Female	31	County Gen...	66	132	0	118	86	Excellent
12	Anderson	Female	45	County Gen...	68	128	0	114	77	Excellent
13	Thomas	Female	42	St. Mary's ...	66	137	0	115	68	Poor
14	Jackson	Male	25	VA Hospital	71	174	0	127	74	Poor
15	White	Male	39	VA Hospital	72	202	1	130	95	Excellent
16	Harris	Female	36	St. Mary's ...	65	129	0	114	79	Good
17	Martin	Male	48	VA Hospital	71	181	1	130	92	Good
18	Thompson	Male	32	St. Mary's ...	69	191	1	124	95	Excellent
19	Garcia	Female	27	VA Hospital	69	131	1	123	79	Fair
20	Martinez	Male	37	County Gen...	70	179	0	119	77	Good
21	Robinson	Male	50	County Gen...	68	172	0	125	76	Good
22	Clark	Female	48	VA Hospital	65	133	0	121	75	Excellent
23	Rodriguez	Female	39	VA Hospital	64	117	0	123	79	Fair
24	Lewis	Female	41	VA Hospital	62	137	0	114	88	Fair
25	Lee	Female	44	County Gen...	66	146	1	128	90	Fair
26	Walker	Female	28	County Gen...	65	123	1	129	96	Good
27	Hall	Male	25	VA Hospital	70	189	0	114	77	Poor

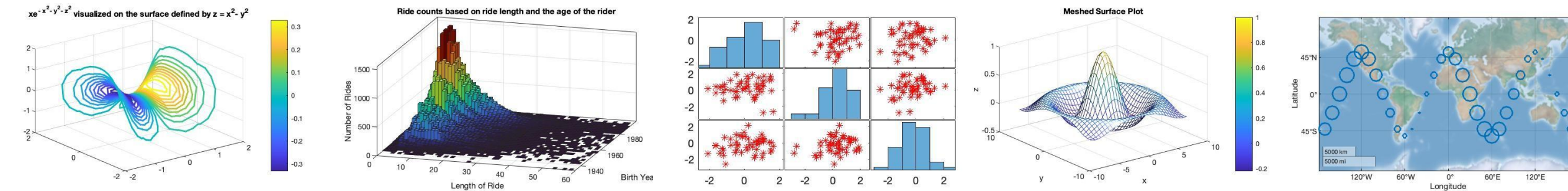
MATLAB for data visualization: Turning Numbers into Pictures

MATLAB provides interactive and highly customizable data visualization tools

Basic plots: Line, Scatter, Bar



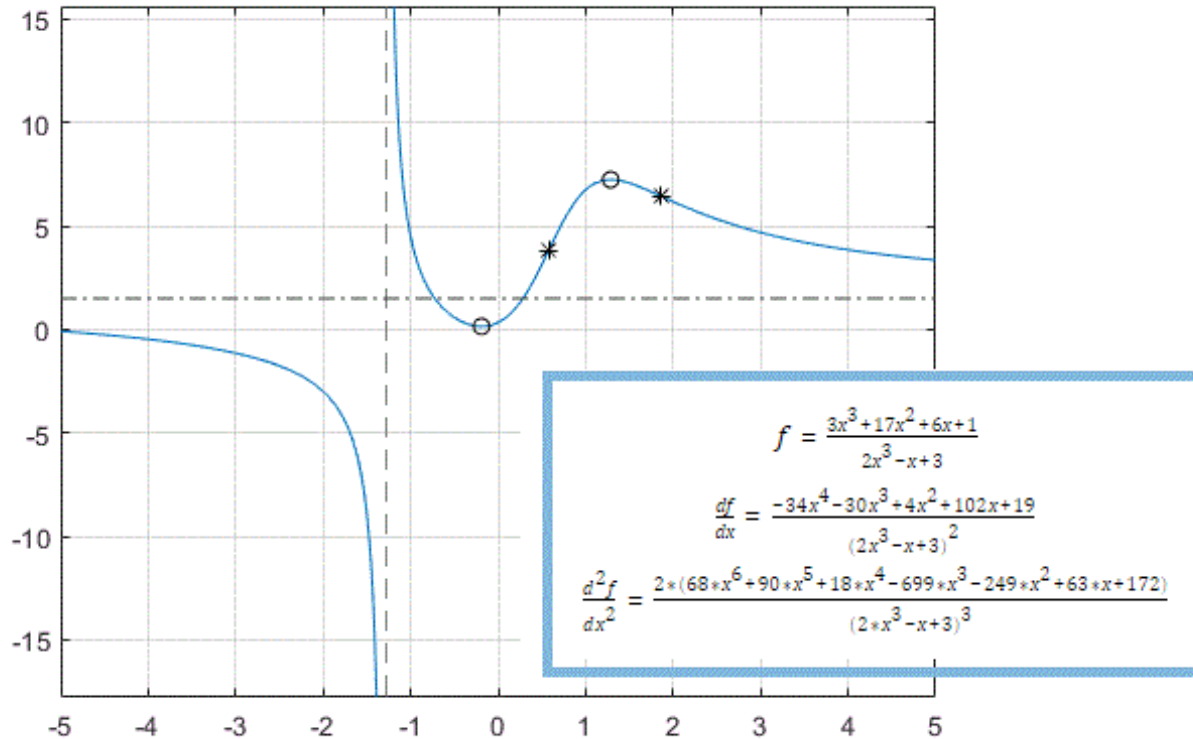
Advanced: Histograms, Contour, 3D plots etc.



- ❖ **Plethora of customization options:** Labels, Legends, Color schemes
- ❖ Can also create complex plots with multiple axes and layers, supports automation

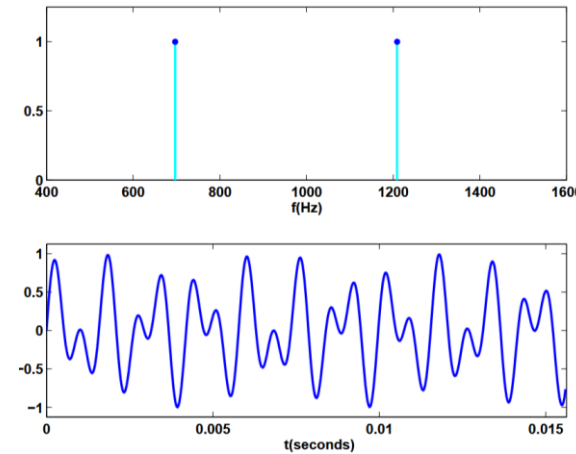
Symbolic math & numerical computation

Symbolic Math Toolbox provides functions for solving, plotting, and manipulating *symbolic math equations*.

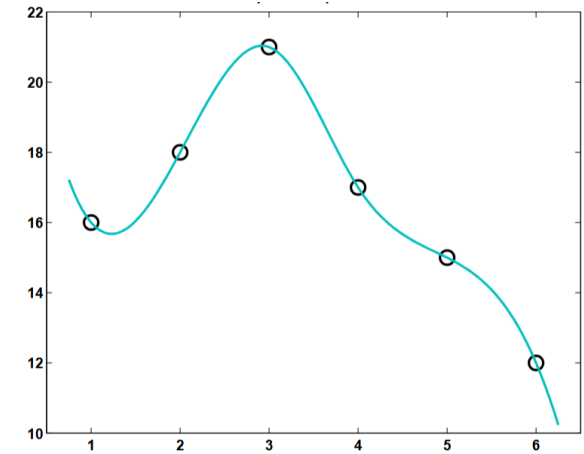


Provides tools for numerical computation such as *interpolation, differentiation, integration* etc.

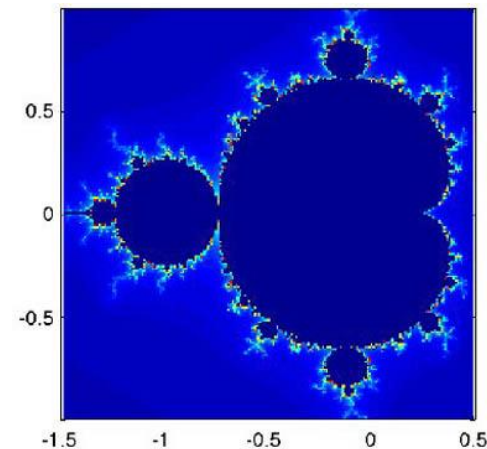
Fourier analysis



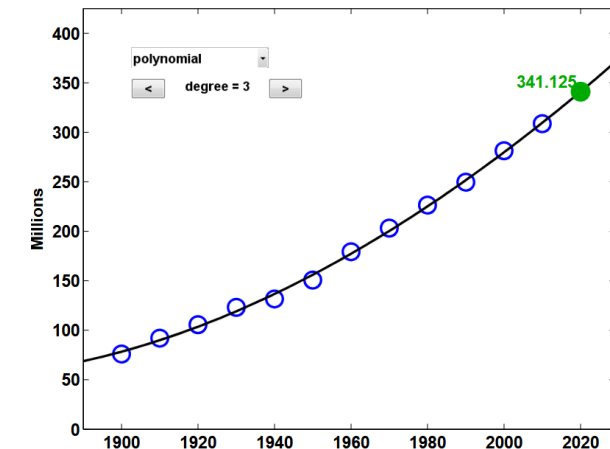
Spline interpolation



Fractals



Curve fitting

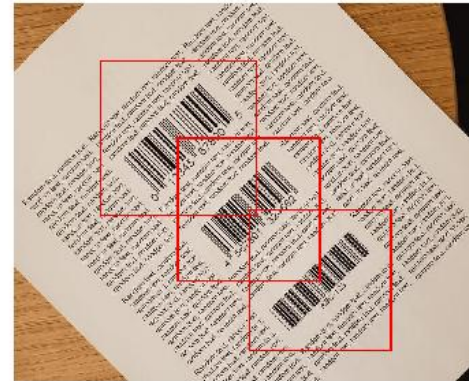
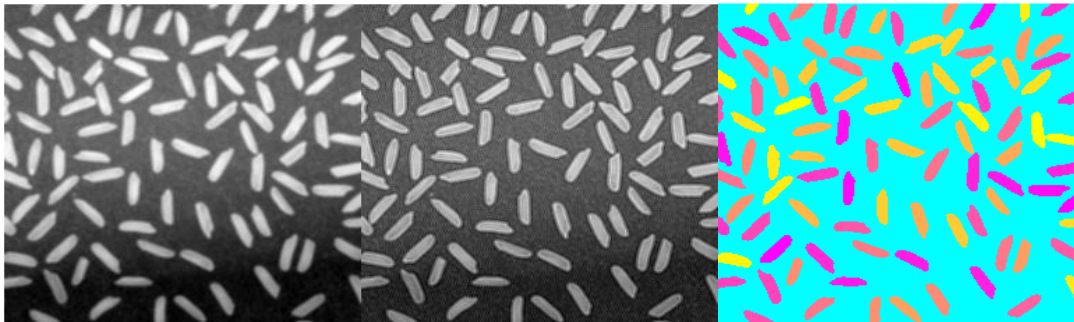


Working with images in MATLAB

❖ Functions to *loading, displaying, preprocessing* images. Supports various kinds of formats; **JPG, PNG, TIFF, BMP** etc.



❖ Tools for **image analysis, filtering, segmentation** etc.



**Extensive support for machine learning,
computer vision etc.**

MATLAB for hardware interfacing

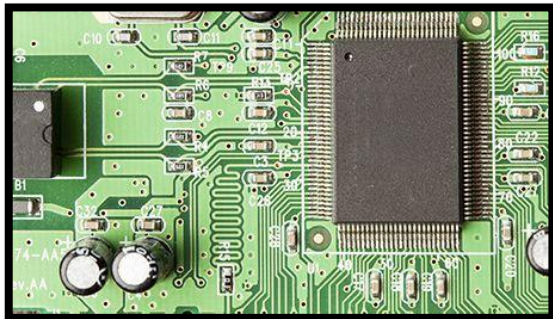


Various instruments e.g., *oscilloscopes, signal generators, multimeters*, etc. can be communicated with using MATLAB's **Instrument Control Toolbox**.

Supports VISA standard using USB, TCP/IP, Serial, and GPIB interfaces.

National Instruments' (NI) data acquisition (DAQ) systems can be used with MATLAB's **Data Acquisition Toolbox**.

Interface sensors, actuators, and signal conditioning equipments, to **acquire real-time analog/digital signals** and logging

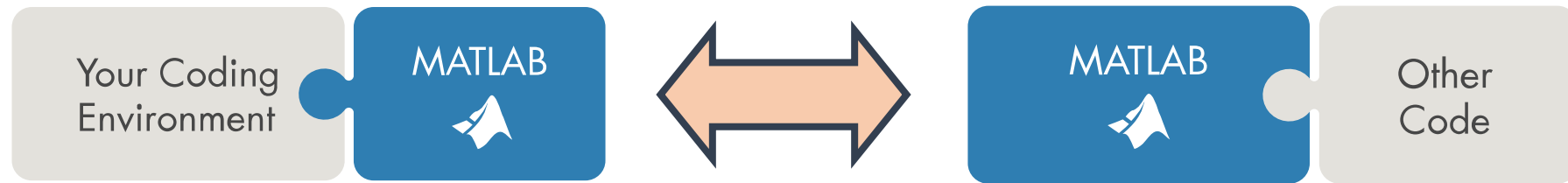


Use HDL Coder to convert MATLAB code to HDL (VHDL/Verilog) for FPGA implementation

Generate code for microcontrollers (e.g., *STM32, Arduino*) using **MATLAB Coder** and **Simulink Support Packages**, supports *Raspberry Pi*

Interaction with other programming languages

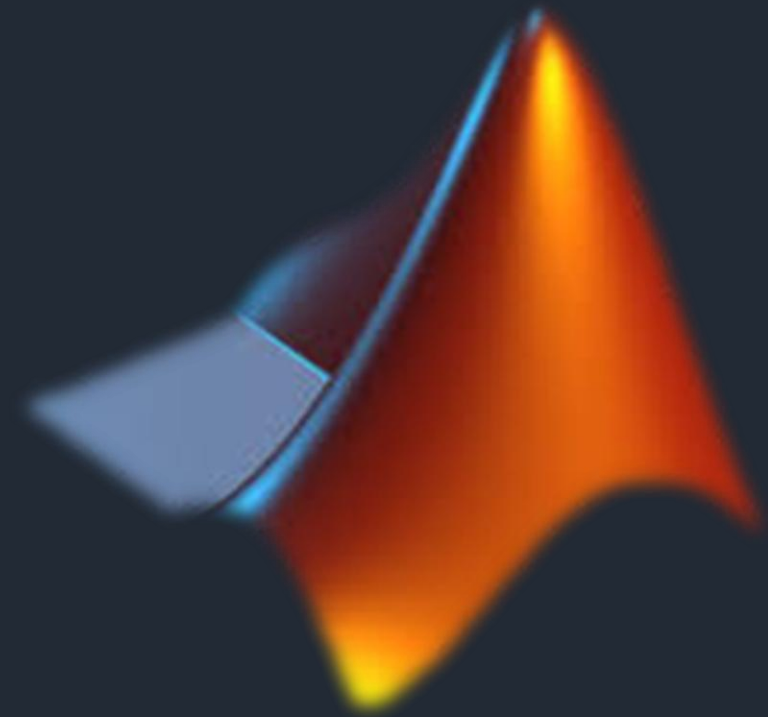
- MATLAB can easily reuse legacy **code written in another programming language**, or **MATLAB codes can be called from other languages**
- Teams that use different programming languages can work together, spending more time developing products and less time recoding in another language.



- C/C++
- Fortran
- Java
- Python
- COM components and applications including many programs written in languages such as Visual C#[®] .NET and Visual Basic[®] .NET

- C++ libraries
- Java libraries
- Python libraries
- C/C++ or Fortran MEX-file functions
- C shared libraries
- .NET libraries
- COM objects
- RESTful and WSDL web services

This workshop provides a golden opportunity
to start enjoy computing with MATLAB
and transform your future...



Workshop Schedule

Know your Tutors !!

Prime Minister's Research Fellows (PMRF) of Department of Physics , IIT Kanpur

Debojit Chanda



Dibyendu Mondal



Suprotim Saha



Javed Akhter Mondal



Goutam Manna



Workshop details

Lecture sessions (2 hour session)

- **11:00 am – 11:30 am** – Lecture session I with problem solving demos
- **11:30 am – 11:45 am** – Questions and discussions
- **11:45 am – 12:00 noon** – Short break
- **12:00 noon – 12:30 pm** – Lecture session II with problem solving demos
- **12:30 am – 12:45 am** – Questions and discussions

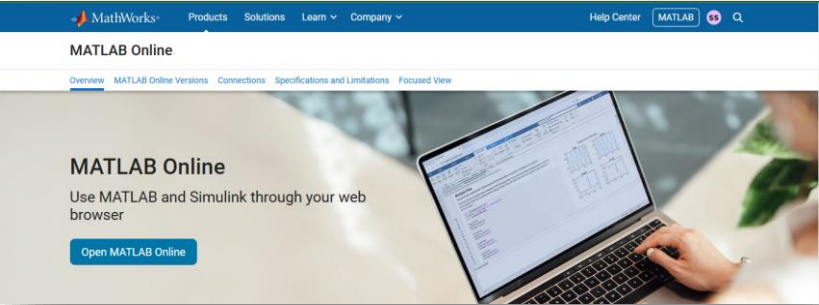
Hands-on sessions (3 hour session)

- **02:00 pm – 03:30 pm** – Hands-on session focussing on problem solving
- **03:30 pm – 03:45 pm** – Short break
- **03:45 pm – 05:00 pm** – Hands-on session focussing on problem solving

Today's hands-on session will focus on;

- ❖ Creating MATLAB account, accessing the online portal
- ❖ Learning about variables and data-types

Accessing MATLAB online



Sign In

Email

By signing in you agree to our [privacy policy](#).

Create Account

Next



Create Account

prithwisghosh306@gmail.com

i To access your organization's MATLAB license, use your work or university email.

This site is protected by reCAPTCHA and the Google [Privacy Policy](#) and [Terms of Service](#) apply.

Next

i To access your organization's license, make sure to use your work or university email.

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Continue anyway

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Create Account

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Next



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Create a MathWorks Account

We just need a little more info to set up your account.

First Name

Prithwis

Last Name

Ghosh

Location

India

Which best describes you?

Student

Department

Physics

What describes your role?

Student (Graduate-level)

Are you at least 13 years or older?

☒ Yes ☐ No

Next

Accessing MATLAB online (contd.)

MATLAB

Search Help Center

Get Help

Documentation

MATLAB Answers

File Exchange

Videos

Learn

Online Training

Cody

Blogs

Your MathWorks account is not linked to an active license.

Choose an option below to get started

Link a License

Link your account to your organization's license

Link

Use MATLAB Online (basic)

Use online up to 20 hours every month

Use now for free

30-day MATLAB Trial

Unlimited use on desktop and online

Get a Trial

Online Training

MATLAB Onramp

Unlimited Access

Start

Simulink Onramp

Unlimited Access

Start

Machine Learning Onramp

Unlimited Access

Start

View more

View all courses

You're one step away from accessing MATLAB Online (basic)

Please complete the form to get started using MATLAB and Simulink through your web browser.

Enter your contact information to continue

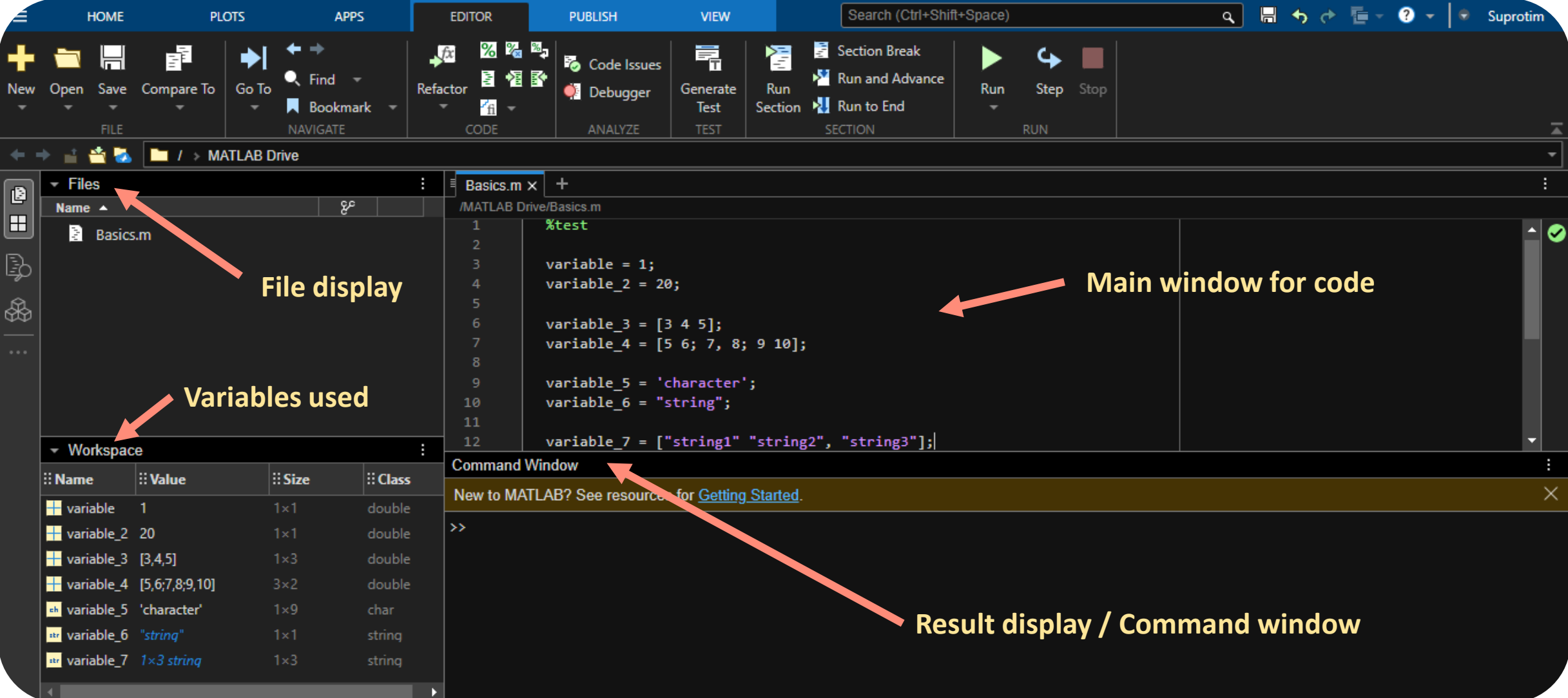
Work or university email*

prithwisghosh306@gmail.com

*Required field

Continue

Getting familiar with the MATLAB window



The image shows the MATLAB desktop environment with several key components labeled:

- File display:** Points to the 'Files' pane on the left, showing the current directory structure.
- Variables used:** Points to the 'Workspace' pane on the left, which lists variables and their properties.
- Main window for code:** Points to the central editor window where the script 'Basics.m' is being edited.
- Result display / Command window:** Points to the 'Command Window' at the bottom, which displays the output of commands.

The MATLAB interface includes a top toolbar with tabs for HOME, PLOTS, APPS, EDITOR, PUBLISH, and VIEW. The EDITOR tab is active, showing the script 'Basics.m' with the following code:

```
1 %test
2
3 variable = 1;
4 variable_2 = 20;
5
6 variable_3 = [3 4 5];
7 variable_4 = [5 6; 7, 8; 9 10];
8
9 variable_5 = 'character';
10 variable_6 = "string";
11
12 variable_7 = ["string1" "string2", "string3"];
```

The Workspace pane shows the following variables:

Name	Value	Size	Class
variable	1	1x1	double
variable_2	20	1x1	double
variable_3	[3,4,5]	1x3	double
variable_4	[5,6;7,8;9,10]	3x2	double
variable_5	'character'	1x9	char
variable_6	"string"	1x1	string
variable_7	1x3 string	1x3	string

The Command Window displays the prompt >> and a message: "New to MATLAB? See resource for Getting Started."

Variables and data types

Data Types	Descriptions
char	Character array
complex	Complex data. Cast function takes real and imaginary components
double	Double-precision floating point
int8 , int16 , int32 , int64	Signed integer
logical	Boolean true or false
single	Single-precision floating point
struct	Structure
uint8 , uint16 , uint32 , uint64	Unsigned integer
Fixed-point	Fixed-point data types

THANK YOU !!

See you during the hands-on session !!