

Assembly line of MatLab, Matplotlib, and L^AT_EX

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1 Introduction

Objective of this project is to learn the uses and analyze the relationship between MatLab [1], Matplotlib [2], and LaTeX [3]. Matlab was used to produce data points. Matplotlib was used to produce a graph. Finally, Latex was used to write the report.

As a beginner, I used various online tutorials, websites and videos to learn the applications of these softwares. Quick online searches about the errors or new features progressively built my knowledge.

Knowledge of these software can be beneficial while writing project reports, research papers, and presentations. You start by programming a mathematical model/simulation in MatLab, generate the visualizations using the data generated by the model using Matplotlib, and prepare the report of your findings using LaTeX. All these skills will make your research paper look fantastic.

2 MatLab

2.1 MatLab Code

MatLab is given an equation which it graphs and extracts coordinates within given the range. Next, it compiles the code and produces a Excel and a PNG file. The Excel file contains a table with x and y values and the PNG file contains the graph. Code is written in MatLab and embedded in LaTeX [4].

Listing 1: Quadratic Equation Model in MatLab

```
1 clc
2 clear all
3
4 % min x-value: spaced by 1: max x-value
5 x = -10: 1: 10;
6 % function
7 y = x'.^2'
8 plot(x, y)
9
10 % column labels for the table values
11 col_header = {'x', 'y'};
12
13 % writing coordinate values into xlsx file
14 xlswrite('quad_coordinates.xlsx', [x(:), y(:)], 'Sheet1', 'A2');
15 xlswrite('quad_coordinates.xlsx', col_header, 'Sheet1', 'A2');
16
17 % saves the plot as png
18 saveas(gcf, 'quad_coordinates.png')
```

2.2 MatLab Plot

MatLab graphed the equation $y = x^2$ in the range $-10 \leq x \leq 10$. The plot was saved as a png file [5]. Check out the plot 1 on page 2.

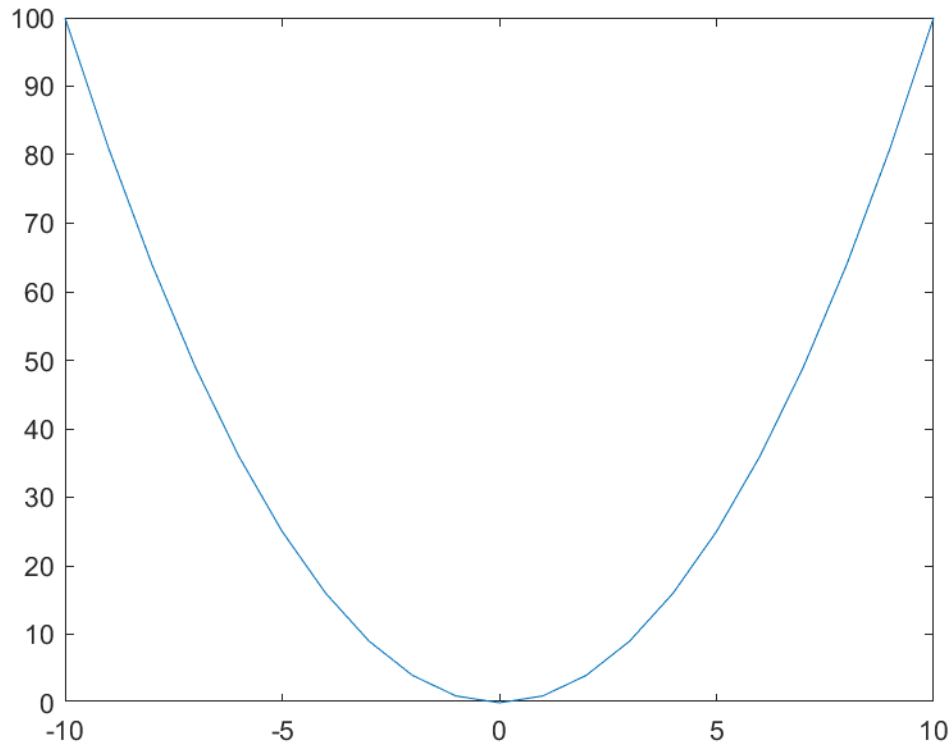


Figure 1: MatLab Simulation Results

3 Matplotlib

You can learn more about the Matplotlib library by auditing a coursera course on Matplotlib called "Applied Plotting, Charting & Data Representation in Python" [6]

3.1 Matplotlib Code

Matplotlib imports the Excel file produced by MatLab and plots the coordinates. Matplotlib code is written in Python and embedded in LaTeX [7].

```
1 // coordinates.py
2 import xlrd
3 import os
4 import matplotlib.pyplot as plt
5 from matplotlib.backends.backend_agg import FigureCanvasAgg
6
7 # setting up the canvas
8 fig = plt.figure()
9 canvas = FigureCanvasAgg(fig)
10
11 # accessing the xlsx file
12 cwd = os.getcwd()
13 data_file = 'c:\workspace\shree\MatLab\quad_coordinates.xlsx'
14 book = xlrd.open_workbook(data_file)
15 sheet = book.sheet_by_name("Sheet1")
```

```

16
17 # reading coordinates from the xlsx file
18 col_x_vals = sheet.col_values(0, 2)
19 col_y_vals = sheet.col_values(1, 2)
20
21 # plotting the coordinates
22 plt.plot(col_x_vals, col_y_vals)
23
24 # customizing the figure
25 plt.xlabel('x values')
26 plt.ylabel('y values')
27 plt.title('Matplotlib plot')
28
29 # saving the figure
30 canvas.print_figure('images/quad_coordinates.eps')
31 canvas.print_figure('c:\workspace\shree\LaTeX\project_report\images\quad_coordinates.eps')

```

3.2 Matplotlib Plot

Matplotlib was used to plot the results and out plot was compared with the one produced by MatLab. The Excel file was imported in Matplotlib and read to get the output data values generated by the model. These values then plotted using the plot function.

After comparing both plots, it was found that the results were similar. Check out the plot 2 on page 3.

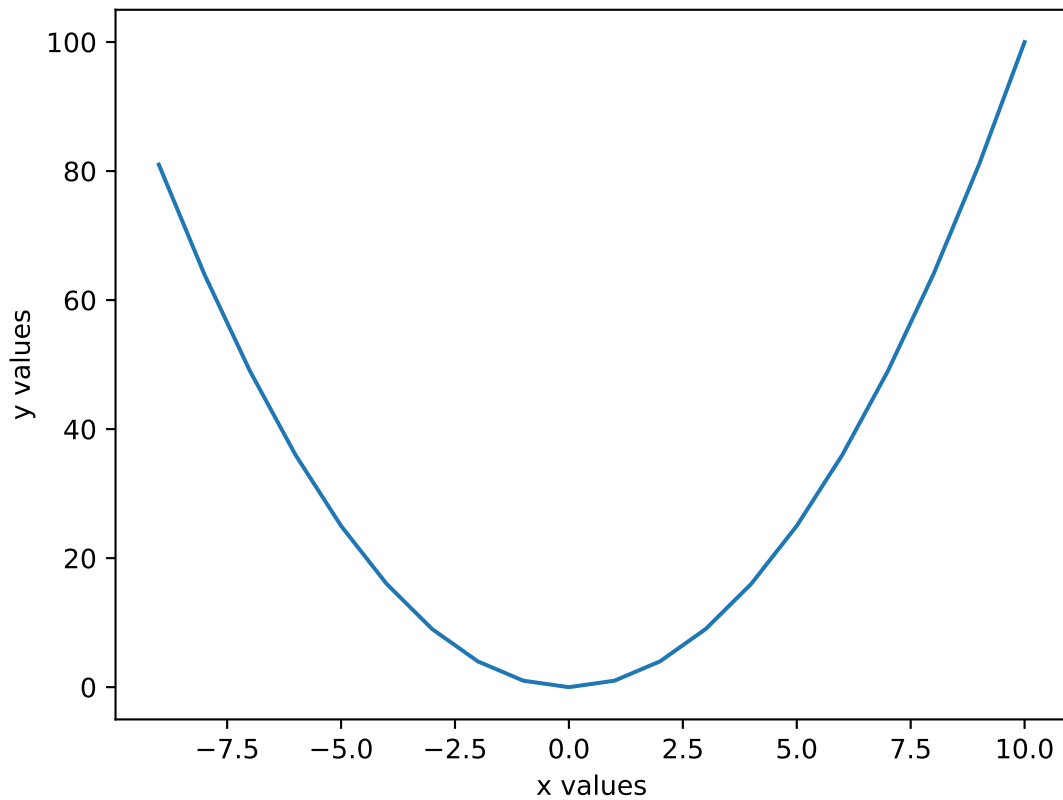


Figure 2: Matplotlib Simulation Results

4 LaTeX

LaTeX imports both - the code written for MatLab and Matplotlib and the generated plots. All four elements are used to create this report. I learned how to:

- add LaTeX packages
- use document classes
- create titles, sections, and subsections
- cite web pages
- embed code and images
- cross reference figures and tables
- write a cross-referencing bibliography
- create itemized list
- create new lines, indentation, and paragraphs
- add page numbers

5 Conclusion

I started using Microsoft Word to write my resume. When my father introduced LaTeX to me, I was quite impressed to see its features and versatility compared to Microsoft Word. I decided to write this report in LaTeX.

I am also enrolled in a course on basic plotting in Matplotlib on Coursera and had some knowledge about MatLab. To utilize my extra lock-down time, I worked on this project through which I learned how all these applications can be used together. It was an interesting learning and exercise.

Finally, both the plots created by MatLab and Matplotlib are similar and follows the quadratic curve. Therefore, it can be concluded that the code is working.

References

- [1] MathWorks, “MathWorks Matlab.” <https://www.mathworks.com/products/matlab.html>.
- [2] matplotlib, “Matplotlib Library APIs.” <https://matplotlib.org/tutorials/index.html>, April 08, 2020.
- [3] D. E. Knuth, “LaTeX – A document preparation system.” <https://www.latex-project.org/>.
- [4] C. Has, “How to Import Matlab Code and Graphics in LaTeX (Latex Advanced Tutorial-14).” <https://www.youtube.com/watch?v=WLqVLNzIN9E>, 2017.
- [5] C. Vellage, “Insert an image in LaTeX - Adding a figure or picture.” <https://www.latex-tutorial.com/tutorials/figures/>, 2017.
- [6] C. Brooks, “Applied Plotting, Charting Data Representation in Python, University of Michigan.” <https://www.coursera.org/learn/python-plotting/home/welcome>, 2008.
- [7] K. M. Fauske, “Embedding Python in LaTeX.” <http://www.texample.net/weblog/2008/oct/24/embedding-python-latex/>, 2008.