

Natasha Piedrabuena  
Numerical Computation  
Homework 9

In this project, we focus on two popular methods: the trapezoidal rule and Simpson's 1/3 rule. These methods are useful for working with data in a table form where the function values are given for specific points. In this project I have written six functions : main(), plot\_results(), find\_missing\_points(), Lagrange(), simpsons\_rule(), and trapezoidal\_rule().

In the main function the user inputs the x, y values or f(x), and h. Then it will find the missing values through the find\_missing\_points() function. It will sort the x values the user input, and then check if it's there, if not append the expected values into the x value list.

```
Enter x values separated by spaces: 1.0 1.1 1.3 1.4 1.5 1.7 1.8
Enter corresponding f(x) values separated by spaces: 1.543 1.669 1.971 2.151 2.352 2.828 3.107
Enter the step size (h): 0.1
```

```
Interpolating missing points...
Interpolated f(1.2) = 1.8106
Interpolated f(1.6) = 2.5766
```

```
Trapezoidal Rule Result: 1.7683
Simpson's Rule Result: 1.7669
```

Data Table:

x	f(x)
1	1.543
1.1	1.669
1.2	1.81064
1.3	1.971
1.4	2.151
1.5	2.352
1.6	2.57664
1.7	2.828
1.8	3.107

Integration Results:

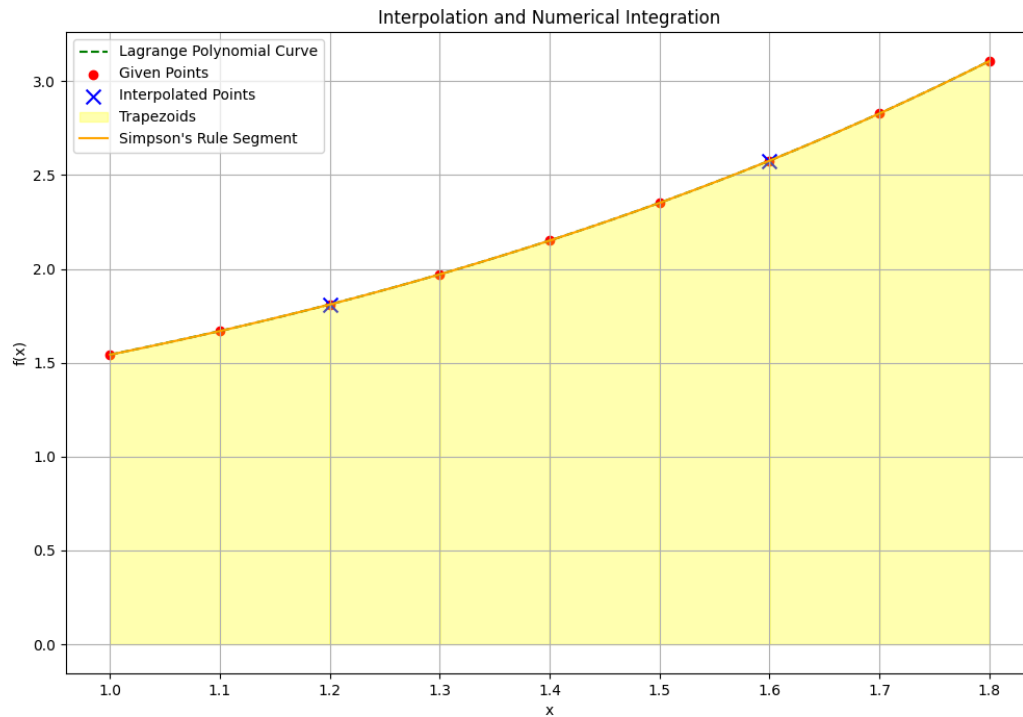
Method	Result
Trapezoidal Rule	1.76833
Simpson's Rule	1.76689

----- Plotting Results -----

```
2024-12-07 14:51:52.361 Python[44759:1023702] +[IMKClient subclass]: chose IMKClient_Modern
2024-12-07 14:51:52.361 Python[44759:1023702] +[IMKInputSession subclass]: chose IMKInputSession_Modern
```

It found the missing points, 1.2 and 1.6 correctly, and interpolated it. The table shows the values from 1.0 to 1.8 with the missing values added. Then its applied to the simpsons rule and trapezoidal rule.

Lastly I plotted everything for testing purposes including:



I used generative AI (ChatGPT) to generate Python functions for the trapezoidal and Simpson's rules. The AI-generated functions closely matched my implementation. After testing, I confirmed that there were some errors when running the code.

```
(venv) natashapiedrabuena@Natashas-MacBook-Pro-3 Homework_9 % python3 AI_main.py
Traceback (most recent call last):
  File "/Users/natashapiedrabuena/Desktop/Fall 2024/numerical_Computation/Homework_9/AI_main.py", line 23, in <module>
    interpolate_missing_points(f)
  File "/Users/natashapiedrabuena/Desktop/Fall 2024/numerical_Computation/Homework_9/AI_main.py", line 15, in interpolate_missing_points
    f[2] = lagrange_interpolation([1.0, 1.3, 1.5], [1.543, 1.971, 2.352], 1.2)
  File "/Users/natashapiedrabuena/Desktop/Fall 2024/numerical_Computation/Homework_9/AI_main.py", line 11, in lagrange_interpolation
    return sum(y[i] * prod((x_target - x[j]) / (x[i] - x[j]) for j in range(len(x)) if i != j) for i in range(len(x)))
  File "/Users/natashapiedrabuena/Desktop/Fall 2024/numerical_Computation/Homework_9/AI_main.py", line 11, in <genexpr>
    return sum(y[i] * prod((x_target - x[j]) / (x[i] - x[j]) for j in range(len(x)) if i != j) for i in range(len(x)))
NameError: name 'prod' is not defined
```