

Python Exercises

Pandas

1. **Data Aggregation:** Write a function that takes a DataFrame with sales data (date, product, amount) and returns the total sales amount for each product, with the result sorted by the total sales in descending order.
2. **Time Series Analysis:** Create a function that takes a DataFrame with a timestamp column and a value column, then returns a new DataFrame with the rolling average of the values over a specified window size.
3. **Missing Data Imputation:** Write a function to fill missing values in a DataFrame using forward fill for NaN values in the temperature column and backward fill for NaN values in the humidity column.
4. **Categorical Encoding:** Develop a function that converts a categorical column in a DataFrame into dummy/one-hot encoded columns and returns the updated DataFrame.
5. **Data Merging:** Create a function that merges two DataFrames on a common column and performs an outer join. The function should handle cases where the columns to be joined may have missing values.

Numpy

6. **Matrix Multiplication:** Write a function that performs matrix multiplication between two NumPy arrays and returns the result. Handle cases where the matrices do not align for multiplication.
7. **Statistical Summary:** Create a function that computes the mean, median, and standard deviation of a NumPy array and returns these statistics in a dictionary.
8. **Element-wise Operations:** Develop a function that takes two NumPy arrays of the same shape and performs element-wise addition, subtraction, multiplication, and division, returning the results as a tuple of arrays.

9. **Fourier Transform:** Write a function that takes a time-domain signal (a NumPy array) and returns its Fourier Transform using `numpy.fft.fft`. Provide both the magnitude and phase of the transform.
10. **Array Reshaping:** Create a function that reshapes a NumPy array into a specified shape and handles cases where the total number of elements does not match the new shape.

Matplotlib

11. **Custom Plot:** Write a function that generates a scatter plot of two arrays with custom markers, colors, and a title. The function should also include a legend and axis labels.
12. **Subplots Creation:** Develop a function that creates a 2x2 grid of subplots where each subplot shows a different type of plot (e.g., line plot, bar plot, histogram, scatter plot). The function should accept data and titles for each subplot.
13. **Error Bars:** Create a function that plots a line graph with error bars. The function should take x values, y values, and corresponding error values as input.
14. **Histograms:** Write a function that creates a histogram of a given dataset and allows for customization of the number of bins and the range of values.
15. **Pie Chart:** Develop a function that generates a pie chart from a list of categories and their corresponding values. The function should include percentage labels on the chart.

Math

16. **Square Root Calculation:** Write a function that computes the square root of a number using the `math` library.
17. **Factorial Computation:** Create a function that calculates the factorial of a non-negative integer using the `math` library.
18. **Power Function:** Write a function that raises a number to a given power using the `math` library.

19. **Natural Logarithm Calculation:** Implement a function to compute the natural logarithm (base e) of a number using the math library.

20. **Trigonometric Functions:** Write a function that calculates the sine, cosine, and tangent of an angle given in degrees using the math library.