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1. Array Operations

i) Create an empty and a full array

In [14]:

```
import numpy as np

empty_array = np.empty((2,3)) #Creates a 2X3 empty array with not initialized el
print("Empty array using numpy.empty() \n", empty_array)
empty_array = []
print("Empty array using list", empty_array, "\n")


full_array = np.full((3, 3), 7)  # Creates a 2x3 array filled with 7
print("Full array using numpy.full() \n", full_array)
full_array = [1] * 5
print("Full array using list", full_array)
```

```
Empty array using numpy.empty()
 [[6.95167060e-310 1.91515980e-095 1.05386693e-311]
 [1.05386693e-311 8.89318163e-323 1.43279037e-322]]
Empty array using list []

Full array using numpy.full()
 [[7 7 7]
 [7 7 7]
 [7 7 7]]
Full array using list [1, 1, 1, 1, 1]
```

ii) Create 2 arrays, one filled with zeros and another filled with one

In [18]:

```
# Array filled with zeros
zeros_array = np.zeros((3, 4), dtype=int)  # Creates a 3x4 array of zeros
print(zeros_array)

# Array filled with ones
ones_array = np.ones((3, 5), dtype=int)  # Creates a 3x5 array of ones
print(ones_array)
```

```
[[0 0 0 0]
 [0 0 0 0]
 [0 0 0 0]]
[[1 1 1 1 1]
 [1 1 1 1 1]
 [1 1 1 1 1]]
```

iii) Perform matrix multiplication between two arrays

In [39]:

```
matrix_1 = np.array([[1, 2], [3, 4]])
matrix_2 = np.array([[5, 6], [7, 8]])

# Perform matrix multiplication
result = np.dot(matrix_1, matrix_2)
print(result)
```

```
[[19 22]
 [43 50]]
```

iv) Convert a numpy array into csv

In [40]:

```
# Create a sample NumPy array
arr = np.array([[1, 2, 3],
                [4, 5, 6]])

# Save the array to a CSV file
np.savetxt("test.csv", arr, delimiter=",", fmt='%d', header='Column1,Column2,Col
# fmt='%d': Specifies the int format of the numbers
# comments='': Prevents from prefixing the header with #

print(f"Array saved to {"test.csv"}")

import pandas as pd

# Read the CSV file into a DataFrame
df = pd.read_csv('test.csv')

print("DataFrame read from CSV file: \n", df)
```

```
Array saved to test.csv
DataFrame read from CSV file:
    Column1  Column2  Column3
0        1        2        3
1        4        5        6
```

v) Plot line graph from NumPy array

In [41]:

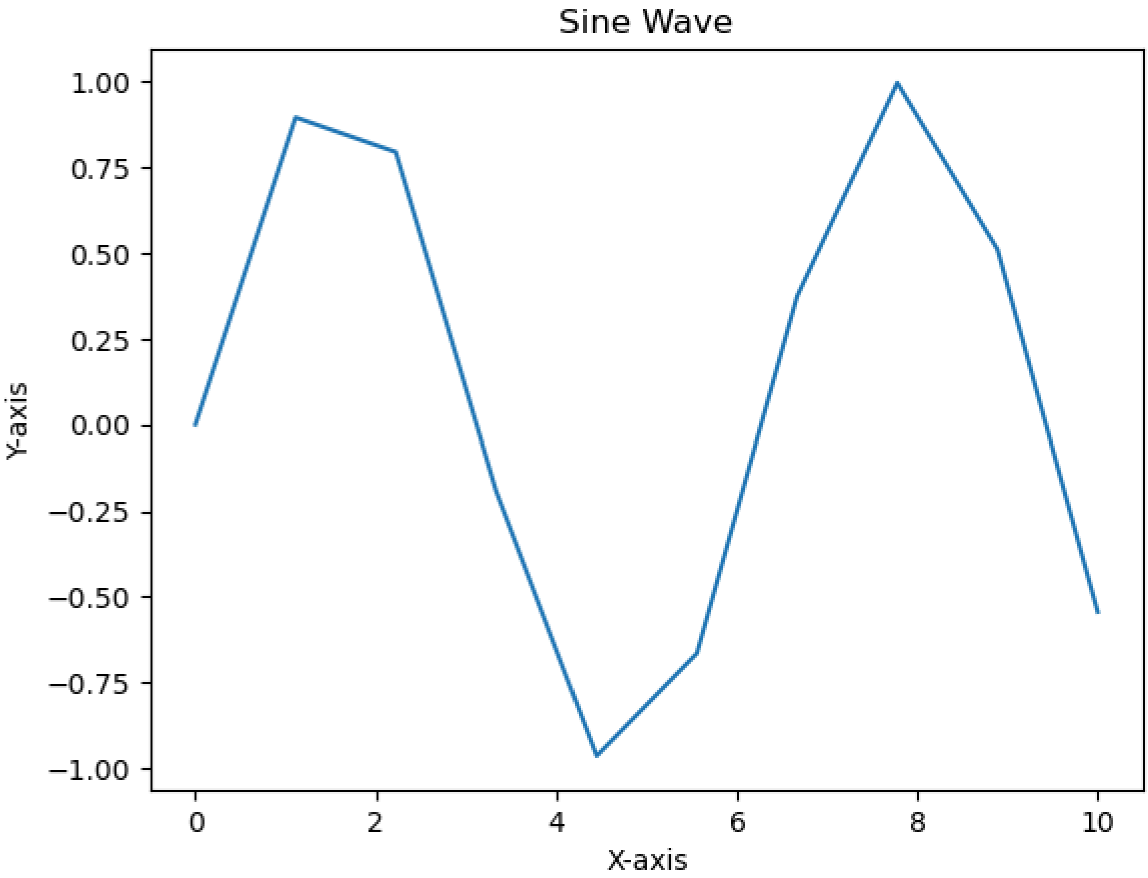
```
import matplotlib.pyplot as plt

# Create a sample NumPy array
x = np.linspace(0, 10, 10)
y = np.sin(x)
```

```
# Plot the line graph
plt.plot(x, y)

# Add labels and a title
plt.xlabel("X-axis")
plt.ylabel("Y-axis")
plt.title("Sine Wave")

plt.show()    # Show the plot
```



2. Build a list that contains prime number btw 1 & 100, in 2 different ways: Using for loops and conditional if statements. Print total no. of prime numbers using a function of list and create a new list which displays these numbers in a descending order.

In [34]:

```
def find_prime_no(start, end):
  prime_numbers = []
  for num in range(start, end + 1):
    if num <= 1:
      continue
    is_prime = True
    for i in range(2, int(num)):
      if num % i == 0:
        is_prime = False
        break
    if is_prime:
      prime_numbers.append(num)
  return prime_numbers

primes = find_prime_no(1, 100)
print(primes)
print("Total prime numbers:", len(primes))

# Create a new list with prime numbers in descending order
primes_descending = sorted(primes, reverse=True)
print("Prime numbers in descending order:", primes_descending)
```

```
[2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73,
79, 83, 89, 97]
Total prime numbers: 25
Prime numbers in descending order: [97, 89, 83, 79, 73, 71, 67, 61, 59, 53, 47, 4
3, 41, 37, 31, 29, 23, 19, 17, 13, 11, 7, 5, 3, 2]
```

3. Generate an array as given ([[1, 2, 3, 4], [5, 6, 7, 8], [9, 10, 11, 12], [13, 14, 15, 16]]), Print its dimensions, dtype.

In [47]:

```
arr = np.array([[1, 2, 3, 4], [5, 6, 7, 8], [9, 10, 11, 12], [13, 14, 15, 16]])
print(arr)
print('Dimensions:', arr.shape)
print('Data type:', arr.dtype)
```

```
[[ 1  2  3  4]
 [ 5  6  7  8]
 [ 9 10 11 12]
 [13 14 15 16]]
Dimensions: (4, 4)
Data type: int32
```

i) Extract the first row from the array

In [57]:

```
first_row = arr[0,:]
print(first_row)
```

```
[1 2 3 4]
```

ii) Extract the last column from the array.

In [54]:

```
last_column = arr[: ,-1]
print(last_column)
```

```
[ 4  8 12 16]
```

iii) Extract the subarray containing the first two rows and the last two columns.

In [58]:

```
subarray = arr[:2, -2:]
print(subarray)
```

```
[[3 4]
 [7 8]]
```

iv) Reverse the order of elements in the second row.

In [62]:

```
arr[1, :] = arr[1, :][::-1]
print(arr)
```

```
[[ 1  2  3  4]
 [ 8  7  6  5]
 [ 9 10 11 12]
 [13 14 15 16]]
```

4. For the given data that represents the monthly average precipitation and temperature of Trivandrum

1. Convert the precipitation to inches and temperature to Fahrenheit

In [8]:

```
import pandas as pd

#Read the csv file into dataframe
filepath= r"C:\Users\Ranjeet Gupta\Downloads\Scientific Computing Lab\Lab2_triva
df = pd.read_csv(filepath, encoding='Latin-1')
# print(df)

# ensure that columns are of string type, then clean and convert to numeric
df['Precipitation / Rainfall mm '] = pd.to_numeric(df['Precipitation / Rainfall
df['Avg. Temperature °C '] = pd.to_numeric(df['Avg. Temperature °C '].astype(str

# Convert precipitation: (1 mm = 0.0393701 inches)
df['Precipitation_inches'] = df['Precipitation / Rainfall mm '] * 0.0393701

# Convert temperature from Celsius to Fahrenheit (F = C * 9/5 + 32)
df['Temperature_F'] = df['Avg. Temperature °C '] * 9/5 + 32

# # Drop the original columns if no longer needed
# df = df.drop(columns=['Precipitation_mm', 'Temperature_C'])

print("Converted Data:")
print(df[['Precipitation_inches', 'Temperature_F']].head())

# Save the updated DataFrame to a new CSV file
output_filename = r"C:\Users\Ranjeet Gupta\Downloads\Scientific Computing Lab\co
df.to_csv(output_filename, index=False)
```

```
print(f"Converted data saved to {output_filename}")

print("\n")
#Display the converted csv file into dataframe
df = pd.read_csv(output_filename, encoding='Latin-1')
print(df)
```

```
Converted Data:
   Precipitation_inches  Temperature_F
0              1.338583          78.08
1              2.244096          78.98
2              4.921263          79.88
3              7.480319          80.42
4              9.291344          79.88
Converted data saved to C:\Users\Ranjeet Gupta\Downloads\Scientific Computing Lab
\converted_trivandrum_weather_data.csv


   Unnamed: 0  Unnamed: 1      Month  Avg. Temperature Â°C   Unnamed: 4  \
0         NaN         NaN    January                   25.6    (78) Â°F
1           ?         NaN   February                   26.1  (78.9) Â°F
2         NaN         NaN      March                   26.6  (79.8) Â°F
3         NaN         NaN      April                   26.9  (80.4) Â°F
4         NaN         NaN        May                   26.6  (79.8) Â°F
5         NaN         NaN       June                   25.4  (77.7) Â°F
6         NaN         NaN       July                   25.0    (77) Â°F
7         NaN         NaN     August                   25.0    (77) Â°F
8         NaN         NaN  September                   25.3  (77.5) Â°F
9         NaN         NaN    October                   25.4  (77.7) Â°F
10        NaN         NaN   November                   25.4  (77.8) Â°F
11        NaN         NaN   December                   25.5  (77.9) Â°F

   Min. Temperature Â°C (Â°F)  Unnamed: 6 Max. Temperature Â°C (Â°F)  \
0                    22.2 Â°C  (71.9) Â°F                   29.6 Â°C
1                    22.6 Â°C  (72.7) Â°F                   30.1 Â°C
2                    23.7 Â°C  (74.6) Â°F                     30 Â°C
3                    24.8 Â°C  (76.6) Â°F                   29.6 Â°C
4                    24.9 Â°C  (76.8) Â°F                   28.8 Â°C
5                      24 Â°C  (75.3) Â°F                   27.4 Â°C
6                    23.6 Â°C  (74.5) Â°F                   27.1 Â°C
7                    23.5 Â°C  (74.4) Â°F                   27.1 Â°C
8                    23.6 Â°C  (74.5) Â°F                   27.6 Â°C
9                    23.5 Â°C  (74.4) Â°F                   27.9 Â°C
10                   23.1 Â°C  (73.6) Â°F                   28.1 Â°C
11                   22.6 Â°C  (72.7) Â°F                   28.7 Â°C

    Unnamed: 8  Precipitation / Rainfall mm   Unnamed: 10 Humidity(%)  \
0   (85.2) Â°F                            34         -1.3         72%
1   (86.2) Â°F                            57         -2.2         74%
2     (86) Â°F                           125         -4.9         80%
3   (85.3) Â°F                           190         -7.5         84%
4   (83.9) Â°F                           236         -9.3         85%
5   (81.4) Â°F                           319        -12.6         89%
6   (80.7) Â°F                           224         -8.8         88%
7   (80.8) Â°F                           186         -7.3         87%
8   (81.7) Â°F                           172         -6.8         86%
9   (82.2) Â°F                           317        -12.5         86%
10  (82.6) Â°F                           252         -9.9         84%
11  (83.7) Â°F                            85         -3.3         77%

    Rainy days (d)  avg. Sun hours (hours)  Precipitation_inches  \
0                4                     9.6              1.338583
1                7                     9.4              2.244096
2               14                     8.7              4.921263
3               19                     7.7              7.480319
4               19                     6.5              9.291344
5               20                     6.1             12.559062
```

```
6            19                      6.6              8.818902
7            18                      6.7              7.322839
8            16                      7.0              6.771657
9            19                      7.2             12.480322
10           16                      8.0              9.921265
11            8                      8.9              3.346458

    Temperature_F
0           78.08
1           78.98
2           79.88
3           80.42
4           79.88
5           77.72
6           77.00
7           77.00
8           77.54
9           77.72
10          77.72
11          77.90
```

2. Plot a graph of the temperature variation

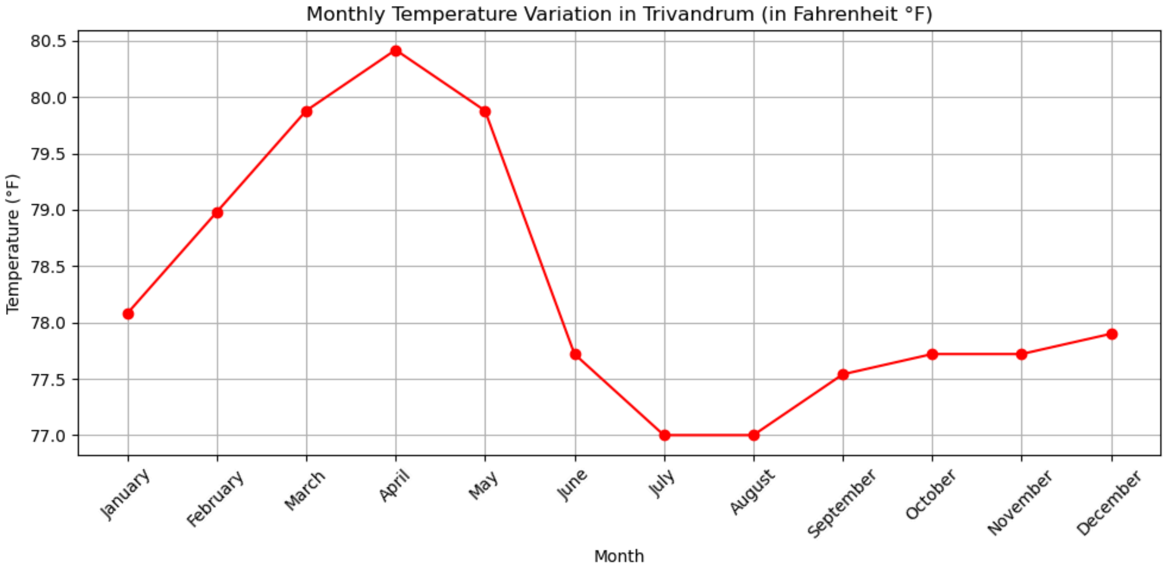
In [3]:

```python
import matplotlib.pyplot as plt

# Plot the temperature variation
plt.figure(figsize=(10, 5))
plt.plot(df['Month'], df['Temperature_F'], marker='o', linestyle='-', color='r')

# Adding titles and labels
plt.title('Monthly Temperature Variation in Trivandrum (in Fahrenheit °F)')
plt.xlabel('Month')
plt.ylabel('Temperature (°F)')
plt.xticks(rotation=45)
plt.grid(True)

# Show the plot
plt.tight_layout()
plt.show()
```


Monthly Temperature Variation in Trivandrum (in Fahrenheit °F)
Temperature (°F)
80.5
80.0
79.5
79.0
78.5
78.0
77.5
77.0
January
February
March
April
May
June
July
August
September
October
November
December
Month

In [ ]:

In [ ]: