NumPy Program in Python

1. Perform Arithmetic operations

```
import numpy as np
# Create NumPy arrays
a = np.array([1, 2, 3, 4, 5])
b = np.array([10, 20, 30, 40, 50])
# Arithmetic operations
sum_array = a + b
diff_array = b - a
product_array = a * b
# Statistics
mean_a = np.mean(a)
max_b = np.max(b)
min_b = np.min(b)
# Display results
print("Array a:", a)
print("Array b:", b)
print("Sum:", sum_array)
print("Difference:", diff_array)
print("Product:", product_array)
print("Mean of a:", mean_a)
print("Max of b:", max_b)
print("Min of b:", min_b)
```

2. How do you create a 2D NumPy array and access specific elements?

```
import numpy as np
# Create a 2D array
arr = np.array([[1, 2, 3], [4, 5, 6]])

# Access elements
print("Element at (0, 1):", arr[0, 1])
print("Second row:", arr[1])
print(arr)
```

3. Add Two Arrays Element-wise

```
a = np.array([5, 10, 15])
b = np.array([1, 2, 3])

# Add arrays
result = a + b
print("Sum:", result)
```

4. Generate Random Numbers and Find Max/Min

```
import numpy as np
rand_array = np.random.randint(1, 100, size=10)
print("Random Array:", rand_array)
```

```
print("Maximum:", np.max(rand_array))
print("Minimum:", np.min(rand_array))
```

5. Reshape and Flatten an Array

How can you change the shape of an array?

```
import numpy as np
arr = np.array([1, 2, 3, 4, 5, 6])
# Reshape to 2x3 matrix
reshaped = arr.reshape(2, 3)
print("Reshaped (2x3):\n", reshaped)

# Flatten back to 1D
flattened = reshaped.flatten()
print("Flattened:", flattened)
```

6. Filter Elements Using Boolean Masking

How do you filter array elements based on a condition?

```
import numpy as np
arr = np.array([10, 20, 30, 40, 50])
# Condition: elements > 25
filtered = arr[arr > 25]
print("Elements > 25:", filtered)
```

7. Matrix Multiplication

How do you multiply two matrices in NumPy?

```
import numpy as np

A = np.array([[1, 2], [3, 4]])
B = np.array([[5, 6], [7, 8]])

# Matrix multiplication
result = np.dot(A, B)

print("Matrix A:\n", A)
print("Matrix B:\n", B)
print("A x B:\n", result)
```

8. Calculate Mean, Median, and Standard Deviation

How do you calculate basic statistics using NumPy?

```
data = np.array([1, 2, 3, 4, 5, 6])

print("Mean:", np.mean(data))
print("Median:", np.median(data))
print("Standard Deviation:", np.std(data))
```

9. Create a Range of Values
How do you create a range of evenly spaced values?

```
# From 0 to 9
a = np.arange(0, 10)

# From 0 to 2π with 10 values
b = np.linspace(0, 2 * np.pi, 10)

print("Arange:", a)
print("Linspace:", b)
```

Note: The linspace() function in Python, part of the NumPy library, is used to generate an array of evenly spaced numbers over a specified interval.

10. Transpose of a Matrix
How do you transpose a matrix in NumPy?

```
matrix = np.array([[1, 2, 3], [4, 5, 6]])

transpose = matrix.T

print("Original:\n", matrix)
print("Transposed:\n", transpose)
```

11. Element-wise Operations with Functions
How do you apply mathematical functions to an array?

```
x = np.array([0, np.pi/2, np.pi])

# Apply sine function
y = np.sin(x)

print("x values:", x)
print("sin(x):", y)
```

12. Create and Display a DataFrame
How do you create a DataFrame from a dictionary?

```
import pandas as pd
# Create DataFrame
data = {
   'Name': ['Alice', 'Bob', 'Charlie'],
   'Age': [25, 30, 22],
   'Score': [85, 90, 95]
}

df = pd.DataFrame(data)
print(df)
```

A DataFrame is a table-like structure used in data analysis.

13. Read a CSV File and Show Basic Info
How do you read a CSV file and view basic information?

```
df = pd.read_csv("students.csv")

print(df.head())      # First 5 rows
print(df.info())      # Data types and non-null counts
print(df.describe())  # Statistics summary
```

read_csv() is used to import datasets into pandas.

14. Filter Rows Based on Condition
How do you filter data where Age > 25?

```
import pandas as pd
data = {
   'Name': ['Asha', 'Ravi', 'Neha'],
   'Age': [24, 29, 26]
}

df = pd.DataFrame(data)

# Filter
filtered_df = df[df['Age'] > 25]
print(filtered_df)
```

15. Group By and Aggregate
How do you group data by category and calculate mean?

```
import pandas as pd
data = {
   'Department': ['CS', 'CS', 'IT', 'IT'],
   'Marks': [85, 90, 78, 82]
}

df = pd.DataFrame(data)

# Group by department and calculate average marks
grouped = df.groupby('Department').mean()
print(grouped)
```

groupby() helps summarize data by category.

16. Add a New Column and Save to CSV
How do you add a calculated column and save it?

```
import pandas as pd
data = {
   'Math': [90, 80, 85],
   'Science': [95, 75, 88]
}
df = pd.DataFrame(data)
# Add average score column
df['Average'] = (df['Math'] + df['Science']) / 2
# Save to CSV
```

```
print(df)
# Save to CSV
df.to_csv("averages.csv", index=False)
```

17. Line Graph
How do you plot a simple line graph in Python?

```
import matplotlib.pyplot as plt

x = [1, 2, 3, 4, 5]
y = [10, 12, 15, 18, 20]

plt.plot(x, y)
plt.title("Simple Line Graph")
plt.xlabel("X values")
plt.ylabel("Y values")
plt.show()
```

18. Bar Graph
How do you create a bar chart?

```
import matplotlib.pyplot as plt

students = ['Asha', 'Ravi', 'Neha']
scores = [85, 90, 78]

plt.bar(students, scores, color='skyblue')
plt.title("Student Scores")
plt.xlabel("Students")
plt.ylabel("Marks")
plt.show()
```

19. Pie Chart
How to create a pie chart to show percentages?

```
import matplotlib.pyplot as plt

labels = ['Python', 'Java', 'C++', 'C']
sizes = [40, 25, 20, 15]

plt.pie(sizes, labels=labels, autopct='%1.1f%%', startangle=140)
plt.title("Programming Language Usage")
plt.axis('equal')  # Make it a circle
plt.show()
```

20. Histogram

```
import matplotlib.pyplot as plt

ages = [18, 22, 21, 25, 30, 30, 27, 25, 22, 19]

plt.hist(ages, bins=5, color='green')
plt.title("Age Distribution")
plt.xlabel("Age")
plt.ylabel("Frequency")
plt.show()
```

21. Scatter Plot
How do you show correlation between two variables?

```
import matplotlib.pyplot as plt

x = [1, 2, 3, 4, 5]
y = [5, 7, 6, 8, 10]

plt.scatter(x, y, color='red')
plt.title("Scatter Plot Example")
plt.xlabel("X values")
plt.ylabel("Y values")
plt.show()
```