Higher-Order Functions in Scala

A Higher-Order Function (HOF) is a function that either:

1. Takes another function as a parameter.

2. Returns another function as its result.

3. Does both.

This concept is fundamental in functional programming, allowing for cleaner, more reusable, and modular code.

Key Features:

- Function Parameters: A higher-order function can accept other functions as input.

- Returning Functions: It can produce other functions as output.

- Flexible Abstraction: HOFs enable powerful abstraction for common operations, such as mapping, filtering, or reducing data.

Examples:

1. Taking Functions as Arguments:

A function that accepts another function to perform operations:

```

def applyOperation(x: Int, y: Int, operation: (Int, Int) => Int): Int = operation(x, y)

val add = (a: Int, b: Int) => a + b

val multiply = (a: Int, b: Int) => a * b

println(applyOperation(10, 5, add))       // Output: 15

println(applyOperation(10, 5, multiply))  // Output: 50
```

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2. Returning Functions:

A function that returns another function:

```

def multiplier(factor: Int): Int => Int = (x: Int) => x * factor

val triple = multiplier(3)

println(triple(5)) // Output: 15
```

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3. Built-in Higher-Order Functions:

Scala's collections library includes many HOFs like `map`, `filter`, `reduce`, etc.

- `map`: Applies a function to every element in a collection.

```
val numbers = List(1, 2, 3, 4)
val squared = numbers.map(x => x * x)
println(squared) // Output: List(1, 4, 9, 16)
```

- `filter`: Keeps elements that satisfy a condition.

```
val numbers = List(1, 2, 3, 4, 5)
val even = numbers.filter(x => x % 2 == 0)
println(even) // Output: List(2, 4)
```

- `reduce`: Combines elements using a specified operation.

```
val numbers = List(1, 2, 3, 4)
val sum = numbers.reduce((a, b) => a + b)
println(sum) // Output: 10
```

Benefits of Higher-Order Functions:

1. Modularity: HOFs allow breaking down problems into smaller, reusable pieces.

2. Code Reuse: Function logic can be abstracted and reused across different parts of the program.

3. Expressive Syntax: Operations on data can be expressed concisely.

Higher-order functions are a cornerstone of functional programming and make Scala particularly powerful for functional-style programming tasks.