

Session 4: Mastering Loops in Programming

Unlock the power of repetition and automation in your code with essential loop structures that every programmer must master.





Why Loops Matter

Automation

Loops eliminate manual repetition, automating tasks that would otherwise require hundreds of lines of duplicate code.

Efficiency

Write once, execute many times. Loops make your programs faster to write and easier to maintain.

Error Reduction

Repetitive code invites typos and inconsistencies. Loops ensure consistent execution every time.

Today, we'll explore three essential loop types—**for**, **while**, and **do-while**—with hands-on examples that bring these concepts to life.

The For Loop: When You Know the Count

01

Initialization

Set your starting point with a counter variable

03

Update

Increment or modify the counter after each iteration

```
for (int i = 1; i <= 5; i++) {  
    System.out.println(i);  
}  
// Output: 1 2 3 4 5
```

The for loop excels when you know exactly how many times to repeat an operation—perfect for counting, iterating through arrays, or processing fixed datasets.

02

Condition

Define when the loop should continue running

04

Execute

Run your code block for each valid iteration

The While Loop: Condition-Controlled Repetition

The while loop checks its condition *before* each iteration, making it ideal when the number of repetitions depends on dynamic conditions or user input.

Syntax: `while (condition) { /* code */ }`

```
int i = 1;  
while (i <= 5) {  
    System.out.println(i);  
    i++;  
}  
// Output: 1 2 3 4 5
```

Use while loops when you're waiting for a specific state change, processing data until a condition is met, or handling situations where the loop might not run at all.



The Do-While Loop: Guaranteed First Run

Execute First

The loop body runs once before any condition check

Then Evaluate

Condition checked after execution—loop continues if true

At Least Once

Guaranteed minimum of one execution regardless of condition

Syntax: do { /* code */ } while (condition);

```
int input;  
do {  
    System.out.println("Enter a number (0 to exit):");  
    input = scanner.nextInt();  
} while (input != 0);
```

Perfect for menu systems, input validation, and any scenario requiring at least one execution before checking continuation conditions.



Key Differences at a Glance



For Loop

- Best for known iteration counts
- Compact syntax with initialization, condition, and update
- Counter-based repetition



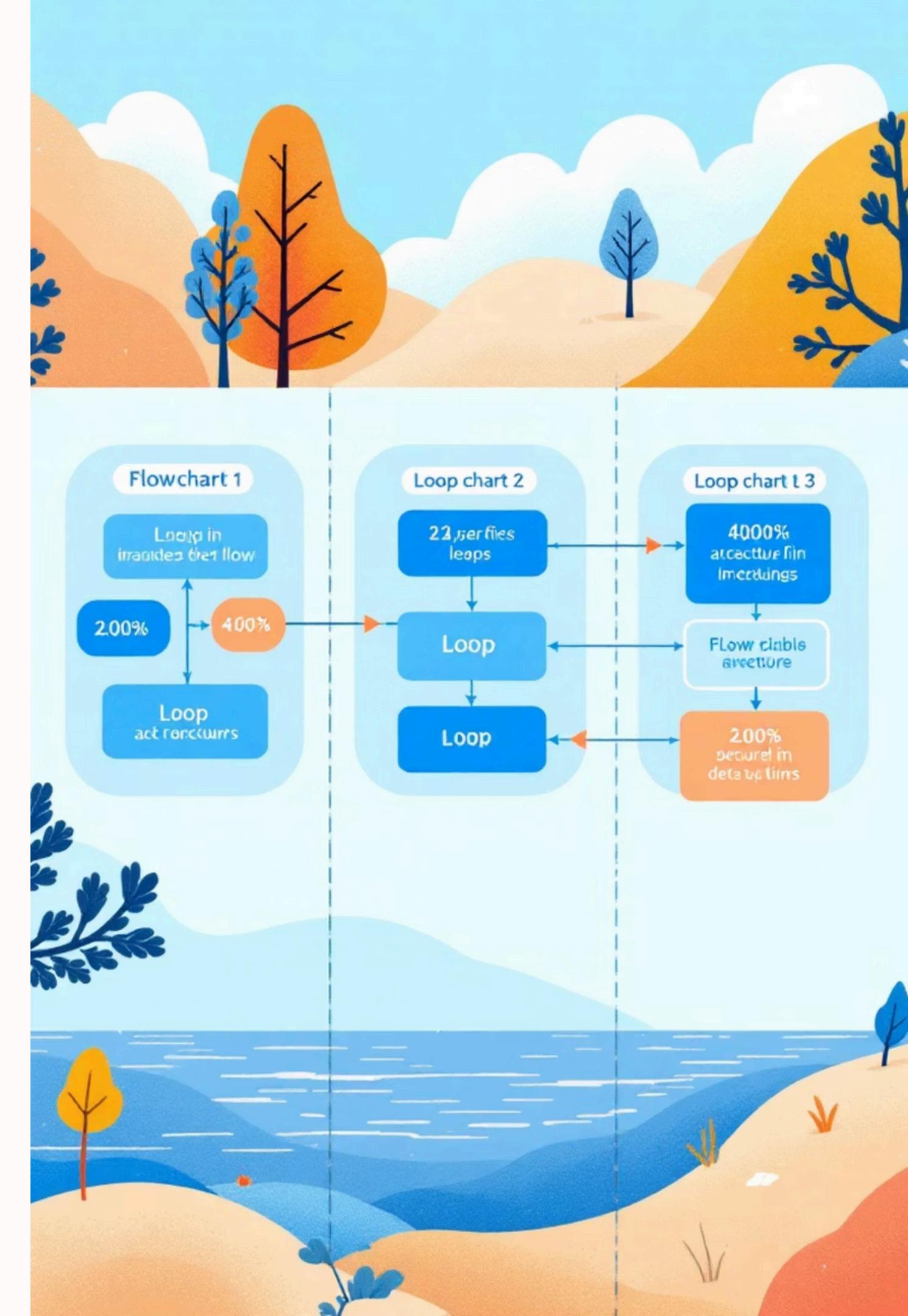
While Loop

- Condition checked **before** execution
- May skip entirely if condition initially false
- Ideal for unknown iteration counts



Do-While Loop

- Condition checked **after** execution
- Guaranteed to run at least once
- Perfect for validation scenarios



Activity 1: Print a Pattern Using Loops

Your Challenge

Use a **for loop** to print a triangle pattern of stars. Each row should have one more star than the previous row.

Expected Output:

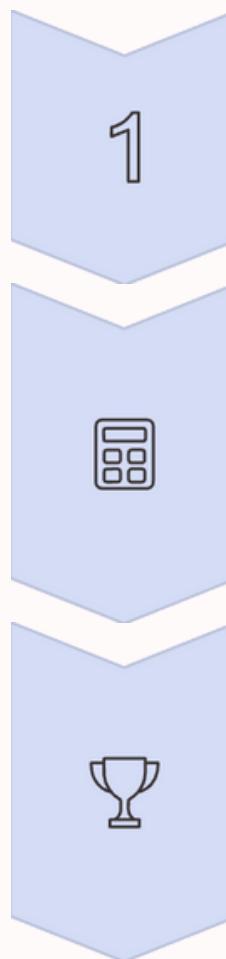
```
*  
**  
***  
****  
*****
```

Bonus Challenge: Can you recreate this pattern using while and do-while loops? Each approach teaches you different ways to think about iteration!



Hint

Activity 2: Calculate the Sum of Numbers



Basic Task

Write a loop to sum all numbers from 1 to N, where N is provided by the user.

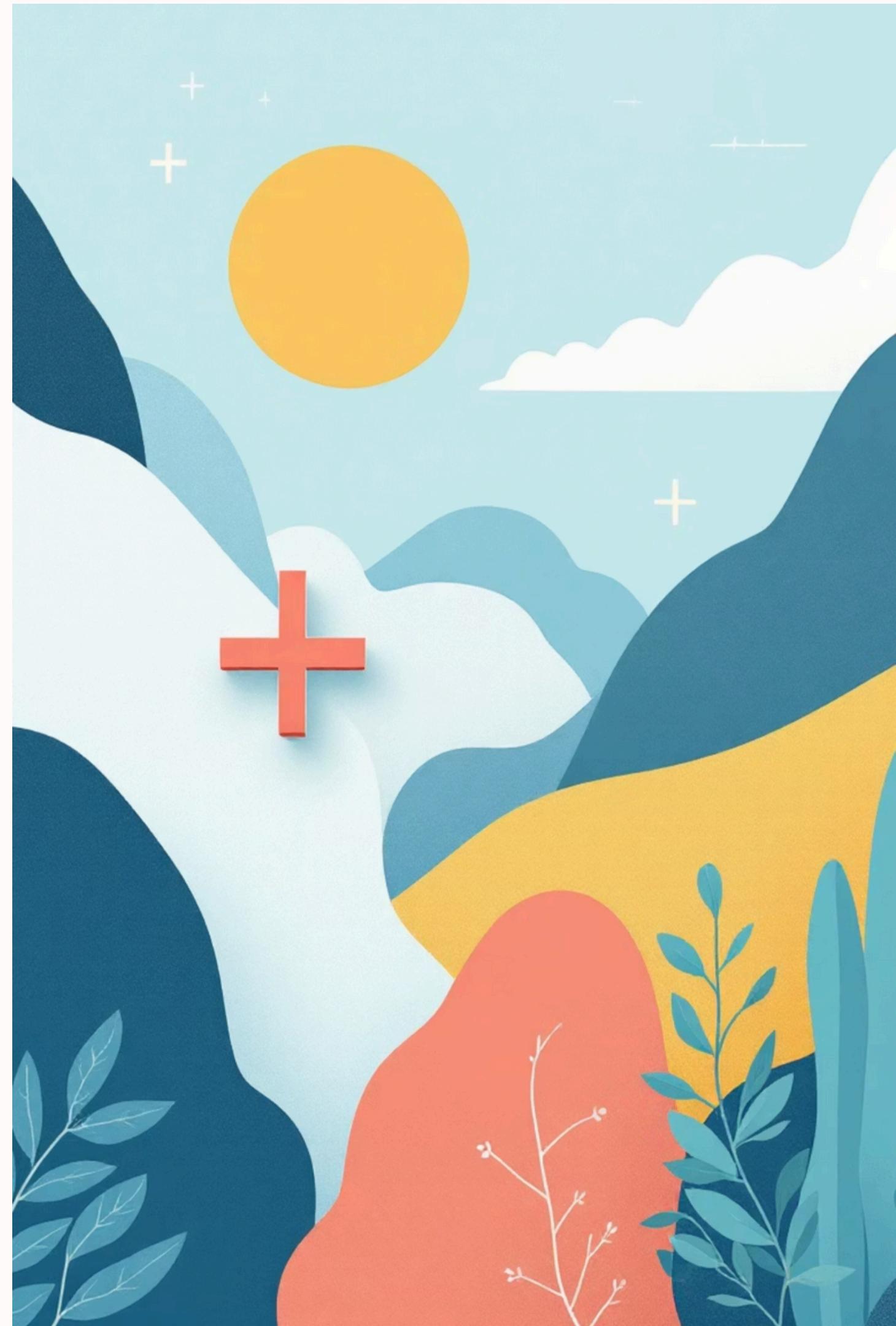
Compare Approaches

Implement the solution using both a for loop and a while loop—notice how each feels different.

Advanced Challenge

Use a do-while loop to continuously accept numbers from the user until they enter 0, then display the total sum.

- Learning Tip:** This activity demonstrates how the same problem can be solved with different loop types. Understanding when to use each is key to writing elegant code.



Common Pitfalls & Best Practices

Infinite Loops

Always ensure your loop variable updates or condition eventually becomes false. An infinite loop will freeze your program!

```
// BAD: i never changes
while (i < 10) {
    print(i);
}
```

Off-By-One Errors

Check your loop boundaries carefully. Does your loop need $i \leq 10$ or $i < 10$? This classic mistake causes bugs.

```
// Runs 10 times (0-9)
for (i = 0; i < 10; i++)
```

Break & Continue

Use break to exit a loop early and continue to skip to the next iteration. Powerful tools when used sparingly.

Readability Matters

Keep loops simple and well-commented. Complex nested loops should be refactored into separate functions for clarity.



Summary & Next Steps



Key Takeaways

Loops automate repetition and are fundamental to efficient programming. Master for, while, and do-while to handle any iteration scenario.



Choose Wisely

Each loop type serves distinct purposes—for counting, while for conditions, do-while for guaranteed execution.



Practice Makes Perfect

Complete the pattern and sum activities to solidify your understanding through hands-on coding.

Coming Up Next

In our next session, we'll explore **nested loops** and advanced control techniques including loop optimization and performance considerations. Get ready to take your loop skills to the next level!

Keep experimenting with loops—they're the gateway to unlocking true programming efficiency and power. 🚀