Introduction to Arrays in C++

From Variables to Collections

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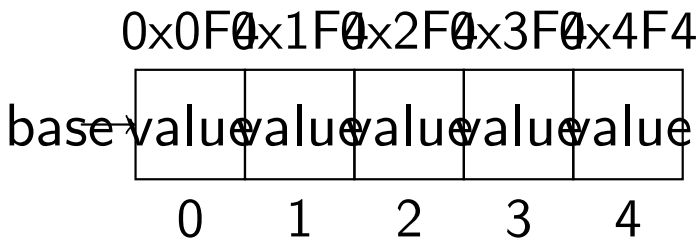
Learning Objectives

After this lesson, you will be able to:

- Understand arrays as contiguous memory structures
- Declare and initialize arrays effectively
- Perform common array operations
- Implement array-based solutions
- Avoid common array pitfalls

Array Memory Layout

- Contiguous memory allocation
- Each element occupies fixed space
- Direct access via index



Array Creation

Declaration Methods

```
1  // Method 1: Declaration with size
2  int temperatures[7];  // Uninitialized array
3
4  // Method 2: Declaration with initialization
5  int scores[5] = {95, 88, 76, 90, 85};
6
7  // Method 3: Size inference
8  int fibonacci[] = {1, 1, 2, 3, 5, 8, 13};
9
10 // Method 4: Partial initialization
11 int values[5] = {0};  // Sets all to 0
```

Working with Arrays

```
int numbers[] = {10, 20, 30, 40, 50};

// Reading elements
int first = numbers[0];     // Get first (10)
int last = numbers[4];      // Get last (50)

// Modifying elements
numbers[2] = 35;            // Change middle element
numbers[4] += 5;            // Increment last element

// Common mistake: bounds
// numbers[5] = 60;         // ERROR: Out of bounds!
```

Array Traversal Patterns

```
1  int data[] = {1, 2, 3, 4, 5};
2  int size = 5;
3
4  // Forward traversal
5  for(int i = 0; i < size; i++) {
6      cout << data[i] << " ";
7  }
8
9  // Reverse traversal
10 for(int i = size - 1; i >= 0; i--) {
11     cout << data[i] << " ";
12 }
13
14 // Skip pattern (every second element)
15 for(int i = 0; i < size; i += 2) {
16     cout << data[i] << " ";
17 }
```

Example: Temperature Analysis

```
1  // Find average daily temperature
2  double getAverageTemp(int temps[], int days) {
3      double sum = 0;
4      for(int i = 0; i < days; i++) {
5          sum += temps[i];
6      }
7      return sum / days;
8  }
9
10 // Find temperature range
11 void getTempRange(int temps[], int days,
12                    int& min, int& max) {
13     min = max = temps[0];
14     for(int i = 1; i < days; i++) {
15         if(temps[i] < min) min = temps[i];
16         if(temps[i] > max) max = temps[i];
17     }
18 }
```

Example: Data Processing

```
1  // Count occurrences in an array
2  int countValue(int arr[], int size, int target) {
3      int count = 0;
4      for(int i = 0; i < size; i++) {
5          if(arr[i] == target) count++;
6      }
7      return count;
8  }
9
10 // Check if array is sorted
11 bool isSorted(int arr[], int size) {
12     for(int i = 1; i < size; i++) {
13         if(arr[i] < arr[i-1]) return false;
14     }
15     return true;
16 }
```

Array Best Practices

Common Pitfalls

- Array bounds violations
- Off-by-one errors in loops
- Uninitialized array access
- Forgetting array size limits

Best Practices

- Always track array size
- Initialize arrays when declared
- Use bounds checking
- Consider using std::array when possible

Key Takeaways

Core Concepts

- Contiguous memory
- Zero-based indexing
- Fixed size
- Type consistency

Operations

- Element access
- Array traversal
- Data processing
- Bounds checking