# **Leetcode 13 – Roman to Integer**

## Problem Understanding

Given a string s representing a **Roman numeral**, convert it into its corresponding **integer** value.

### Roman Numeral Rules:

* I = 1
* V = 5
* X = 10
* L = 50
* C = 100
* D = 500
* M = 1000

Special subtractive rules:

* IV = 4, IX = 9
* XL = 40, XC = 90
* CD = 400, CM = 900

### Goal:

Parse the string from **left to right**, apply Roman numeral rules, and compute the total.

## Optimized Java Solution (Simple Mapping + Left-to-Right Check)

class Solution {

public int romanToInt(String s) {

Map<Character, Integer> map = new HashMap<>();

map.put('I', 1);

map.put('V', 5);

map.put('X', 10);

map.put('L', 50);

map.put('C', 100);

map.put('D', 500);

map.put('M', 1000);

int total = 0;

for (int i = 0; i < s.length(); i++) {

int val = map.get(s.charAt(i));

if (i + 1 < s.length() && val < map.get(s.charAt(i + 1))) {

total -= val; // Subtract for special cases like IV, IX, etc.

} else {

total += val;

}

}

return total;

}

}

## Dry Run Using Table

### Input: s = "MCMXCIV"

Expected Output: 1994

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| i | s[i] | s[i+1] | val | Action (Compare with next) | total |
| 0 | M | C | 1000 | 1000 > 100 → add | 1000 |
| 1 | C | M | 100 | 100 < 1000 → subtract | 900 |
| 2 | M | X | 1000 | 1000 > 10 → add | 1900 |
| 3 | X | C | 10 | 10 < 100 → subtract | 1890 |
| 4 | C | I | 100 | 100 > 1 → add | 1990 |
| 5 | I | V | 1 | 1 < 5 → subtract | 1989 |
| 6 | V | — | 5 | No next → add | 1994 |

✅ Final Answer: **1994**

## Time / Space Complexity

|  |  |
| --- | --- |
| Metric | Value |
| Time | O(n) |
| Space | O(1) |

* The map has only 7 entries → constant space.
* One pass through the string.

## Alternate Approaches

|  |  |  |  |
| --- | --- | --- | --- |
| Approach | Time | Space | Notes |
| ✅ HashMap + Check | O(n) | O(1) | Most readable and flexible |
| Array Indexing | O(n) | O(1) | Slightly faster, but less clean |
| Switch Statements | O(n) | O(1) | Avoids map, good for low-level |