

C++ Programming For Loops Practice

Mostafa S. Ibrahim

Teaching, Training and Coaching since more than a decade!

Artificial Intelligence & Computer Vision Researcher

PhD from Simon Fraser University - Canada

Bachelor / Msc from Cairo University - Egypt

Ex-(Software Engineer / ICPC World Finalist)



Practice: Special Sum

- Read T for number of test cases. For each test case read integer N: number of numbers. Then read N numbers a, b, c, and compute the **sum** of:
 - $(a, b*b, c*c*c, d*d*d*d, e*e*e*e*.....)$
 - That is the k-th number is repeated k times
- Input:
 - 2
 - 3 5 7 2
 - 4 1 2 3 4
- Output
 - 62 [as $(5 + 7*7 + 2*2*2) = 62$]
 - 288 [as $(1+2*2+3*3*3+4*4*4*4) = 288$]
- Stop video and code using for loop

Practice: Special Sum

```
4 int main() {  
5     int N, T, value;  
6  
7     cin >> T;  
8  
9     while (T--) {  
10         cin >> N;  
11  
12         int sum = 0;  
13         for (int i = 0; i < N; ++i) {  
14             cin >> value;  
15  
16             int result = 1;  
17             for (int j = 0; j < i + 1; ++j)  
18                 result *= value;  
19             sum += result;  
20         }  
21         cout << sum << "\n";  
22     }  
23  
24     return 0;  
25 }
```

- Let's rewrite the previous code
- We keep the while as more convenient
 - While (T--) is shortcut for While (T-- != 0)
- Replace as 2 whiles with 2 fors

Practice: Pair of numbers

- Read N, M, SUM. Find all pairs that has $A + B == SUM$ where
 - $1 \leq A \leq N$
 - $1 \leq B \leq M$
- Stop video and code
- Try input
 - 1000000 1000000 1000000
 - How many steps the code do?

```
3
4 int main() {
5     int n, m, sum;
6
7     cin >> n >> m >> sum;
8
9     int cnt = 0;
10
11     for (int i = 1; i <= n; ++i)
12         for (int j = 1; j <= m; ++j)
13             if (i + j == sum)
14                 cnt++;
15
16
17     cout << cnt << "\n";
18
19     return 0;
20 }
21
--
```

Problems Console Tasks Properties

<terminated> ztemp [C/C++ Application] /home/moust

200 300 70

69

Practice: Pair of numbers - FASTER

```
4 int main() {  
5     int n, m, sum;  
6  
7     cin >> n >> m >> sum;  
8  
9     int cnt = 0;  
10  
11     for (int i = 1; i <= n; ++i)  
12     {  
13         int j = sum - i;    // i + j == sum  
14  
15         if (1 <= j && j <= m)  
16             cnt++;  
17     }  
18  
19     cout << cnt << "\n";  
20  
21     return 0;  
22 }  
23  
24
```

- Second loop was useless as only maximum 1 j will have value that matches sum
- With simple math, we can know the possible value of j
 - Then verify its range
- This code takes like $3n$ steps
 - So for 1000000, just 3-4 milion

Practice: Triples of numbers

- Read N, M, W. Find all triples that has $A + B \leq C$ where
 - $1 \leq A \leq N$
 - $A \leq B \leq M$
 - $1 \leq C \leq W$
- Stop video and code

```
4 int main() {  
5     int n, m, w;  
6  
7     cin >> n >> m >> w;  
8  
9     int cnt = 0;  
10  
11     for (int i = 1; i <= n; ++i)  
12         for (int j = i; j <= m; ++j)  
13             for (int k = 1; k <= w; ++k)  
14                 if (i + j <= k)  
15                     cnt++;  
16  
17     cout << cnt << "\n";  
18  
19     return 0;  
20 }  
21
```

Problems Console Tasks Properties 1010 0101

<terminated> ztemp [C/C++ Application] /home/moustafa

100 200 20

715

Practice: Triples of numbers - FASTER

- We can use the same trick
- Remove the very inner loop
- But this is good for $i+j == k$ not $i+j \leq k$??
- Still simple math can do it
 - We from k to w all are valid
 - So we add this range
 - E.g. if $k = 4$, $w = 7$
 - Then 4, 5, 6, 7 are correct values
 - So we add $w-k+1$

```
4 int main() {
5     int n, m, w;
6
7     cin >> n >> m >> w;
8
9     int cnt = 0;
10
11     for (int i = 1; i <= n; ++i)
12         for (int j = i; j <= m; ++j) {
13             int k = i + j;
14
15             if (1 <= k && k <= w)
16                 cnt += w - k + 1;
17         }
18
19     cout << cnt << "\n";
20
21     return 0;
}
```

Problems Console Tasks Properties

<terminated> ztemp [C/C++ Application] /home/mo

100 200 20

715

Fibonacci Sequence

- A popular math sequence
 - First 2 numbers: 0 1
 - Then each number is sum of last 2 numbers:
 - 0 1 1 2 3 5 8 13 21 34
 - E.g. $13 = 5 + 8$
 - E.g. $34 = 13 + 21$
- Write a code!

```
3
4 int main() {
5     int n = 10;
6
7     int a = 0, b = 1;
8
9     cout<<a<<" "<<b<<" ";
10
11     for (int cnt = 2; cnt < n; ++cnt) {
12         int c = a+b;
13         a = b;
14         b = c;
15
16         cout<<c<<" ";
17     }
18
19     return 0;
20 }
21
```

Problems Console Tasks Properties 1010 0101 C

<terminated> ztemp [C/C++ Application] /home/moustafa,
0 1 1 2 3 5 8 13 21 34 |

Fibonacci Sequence

- Same code but written in different way
 - 1) For loop can spread several lines
 - 2) Initialization can initialize several variables
 - 3) Step can changes several variables

```
5
4 int main() {
5     int n = 10;
6
7     for (int a = 0, b = 1, c = -1, cnt = 0; cnt < n;
8         ++cnt, c = a + b, a = b, b = c)
9         cout << a << " ";
10
11     return 0;
12 }
13
```

Your turn

- Repeat all the **while loop** homework, but using for loops

“Acquire knowledge and impart it to the people.”

“Seek knowledge from the Cradle to the Grave.”