INDIAN INSTITUTE OF TECHNOLOGY ROORKEE
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CSC-101 PROGRAMMING WITH C AND C++
Autumn 2023

Quiz 1   Total Marks: 10 (including 2 marks for attendance)   Time - 50 mins.

Note: Full justification and arguments are required for all questions. Simple answers without proper reasoning will not carry any weight.

1. Examine the code below:

```c
#include<stdio.h>
int main()
{
    int x = 2, y = 4, z = 6;
    if (z / 2 == y || x * 2 != z)
        printf("%d %d %d", ++x, y--, --z);
    else
        printf("%d %d %d", x--, --y, z++);
    return 0;
}
```

What will be the output of the above code?   [**2 Marks**]

Sol.

$$x = 2, \quad y = 4, \quad z = 6$$

The conditional statement to evaluate is:

$$\frac{z}{2} == y \quad \text{OR} \quad x \times 2 \neq z$$

1. Evaluating $\frac{z}{2} == y$: Given $z = 6$ and $y = 4$:

$$\frac{6}{2} = 3$$

Which is not equal to 4. Hence, this condition is FALSE.

2. Evaluating $x \times 2 \neq z$: Given $x = 2$ and $z = 6$:

$$2 \times 2 = 4$$

Which is not equal to 6. Hence, this condition is TRUE.

Since one of the conditions (the second one) is TRUE, and we are using the OR operator, the overall condition is TRUE.

Thus, the code inside the if-block is executed:

1

Here:
- x is pre-incremented, so $x = 2 + 1 = 3$.
- y is post-decremented, so it remains $y = 4$ for the current operation but will become 3 afterward.
- z is pre-decremented, so $z = 6 - 1 = 5$.

The output is:
$$3 \quad 4 \quad 5$$

2. Consider the following code:

```c
#include<stdio.h>
int main()
{
    int i = 1;
    while (i <= 20) {
        printf("%d/2 ", i);
        i *= 2;
    }
    return 0;
}
```

If $(a_n)_1^N$ represents the sequential output of the above script, what will be the value of $\dfrac{a_1 + a_N}{a_{\lfloor \frac{N}{2} \rfloor}}$? Here, $\lfloor . \rfloor$ denotes the greatest integer function. **[3 Marks]**

Sol.

The code initializes an integer 'i' with a value of 1. The 'while' loop will execute its body as long as the condition 'i ¡= 20' holds true. Inside the loop, the value of 'i' is printed followed by '/2', and then 'i' is doubled with 'i *= 2'.

To understand the output sequence $(a_n)_1^N$, let's list down the values of 'i' that will be printed:

1. Start: $i = 1$. Since $i \leq 20$, print '1/2'.
2. Double i to get $i = 2$. Since $i \leq 20$, print '2/2'.
3. Double i to get $i = 4$. Since $i \leq 20$, print '4/2'.
4. Double i to get $i = 8$. Since $i \leq 20$, print '8/2'.
5. Double i to get $i = 16$. Since $i \leq 20$, print '16/2'.
6. Double i to get $i = 32$. Now, $i > 20$ so the loop terminates.

From the above iterations, the output sequence $(a_n)_1^N$ is: 1/2, 2/2, 4/2, 8/2, 16/2. Thus, $N = 5$.

Given that:
$$a_1 = 1/2, \quad a_N = 16/2, \quad \text{and} \quad a_{\lfloor \frac{N}{2} \rfloor} = a_{\lfloor \frac{5}{2} \rfloor} = a_2 = 2/2$$

The value of

$$\frac{a_1 + a_N}{a_{\lfloor \frac{N}{2} \rfloor}}$$

will be:

$$\frac{1 + 16}{2}$$

$= 8.5$.

3. Analyze the following code snippet:

```c
#include<stdio.h>
int main()
{
    int i = 3;
    while(printf("%d", i) && (i-- > 0))
    {
        printf("Pragyan is out of the lander! ");
    }
    return 0;
}
```

If b represents the number of blanks in the output of above code, and v denotes the number of vowels then report the value of $\lceil \frac{v}{b} \rceil$? Here, $\lceil . \rceil$ denotes the least integer function.

[**3 Marks**]

Sol.

An integer variable i is initialized to 3.

The 'while' loop's condition performs two tasks:

- The 'printf("%d", i)' function prints the current value of i. This function returns the number of characters printed, which will always be non-zero as long as i has a value.

- The condition evaluates whether i is greater than 0 and then decrements i by 1.

Inside the loop, the string "Pragyan is out of the lander! " is printed.

The loop will continue as long as both parts of the condition are true.

Execution Trace:

- First Iteration: $i = 3$. The number 3 is printed, then the string. After this iteration, i becomes 2.

- Second Iteration: $i = 2$. The number 2 is printed, then the string. After this iteration, i becomes 1.

- Third Iteration: $i = 1$. The number 1 is printed, then the string. After this iteration, i becomes 0.

- Fourth Iteration: $i = 0$. Only the number 0 is printed as the second part of the condition becomes false. The loop exits after this.

The combined output is: '3Pragyan is out of the lander! 2Pragyan is out of the lander! 1Pragyan is out of the lander! 0'

From the output:

- Number of blanks (b): 18
- Number of vowels (v): 27
Therefore, the value of $\left\lceil \frac{v}{b} \right\rceil$ is 2.