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Generate 0 and 1 with 25% and 75% probability

Difficulty Level : Medium • Last Updated : 06 Nov, 2021

Given a function `rand50()` that returns 0 or 1 with equal probability, write a function that returns 1 with 75% probability and 0 with 25% probability using `rand50()` only. Minimize the number of calls to `rand50()` method. Also, use of any other library function and floating point arithmetic are not allowed.

Recommended: Please try your approach on [{IDE}](#) first, before moving on to the solution.

The idea is to use **Bitwise OR**. A bitwise OR takes two bits and returns 0 if both bits are 0, while otherwise the result is 1. So it has 75% probability that it will return 1.

Below is the implementation of above idea :

C++

```
// Program to print 1 with 75% probability and 0
// with 25% probability
#include <iostream>
using namespace std;

// Random Function to that returns 0 or 1 with
// equal probability
```

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```
// probability and 0 with 25% probability using
// Bitwise OR
bool rand75()
{
    return rand50() | rand50();
}

// Driver code to test above functions
int main()
{
    // Initialize random number generator
    srand(time(NULL));

    for(int i = 0; i < 50; i++)
        cout << rand75();

    return 0;
}
```

Java

```
// Java program to print 1 with 75% probability and 0
// with 25% probability
class GFG
{
    // Random Function to that returns 0 or 1 with
    // equal probability
    static int rand50()
    {
        // rand() function will generate odd or even
        // number with equal probability. If rand()
        // generates odd number, the function will
        // return 1 else it will return 0.
        return (int) (10 * Math.random()) & 1;
    }

    // Random Function to that returns 1 with 75%
```

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```
{  
    // Initialize random number generator  
    //srand(time(null));  
  
    for (int i = 0; i < 50; i++)  
    {  
        System.out.print(rand75());  
    }  
}  
  
}
```

// This code is contributed by 29AjayKumar

PHP

```
<?php  
// Program to print 1 with 75% probability  
// and 0 with 25% probability  
  
// Random Function to that returns 0 or  
// 1 with equal probability  
function rand50()  
{  
  
    // rand() function will generate  
    // odd or even number with equal  
    // probability. If rand() generates  
    // odd number, the function will  
    // return 1 else it will return 0.  
    return rand() & 1;  
}  
  
// Random Function to that returns  
// 1 with 75% probability and 0  
// with 25% probability using  
// Bitwise OR
```

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```
for($i = 0; $i < 50; $i++)  
    echo rand75();
```

```
// This code is contributed m_kit  
?>
```

Javascript

```
<script>  
// Program to print 1 with 75% probability and 0  
// with 25% probability  
  
// Random Function to that returns 0 or 1 with  
// equal probability  
function rand50() {  
    // rand() function will generate odd or even  
    // number with equal probability. If rand()  
    // generates odd number, the function will  
    // return 1 else it will return 0.  
    return Math.floor(Math.random() * 10) & 1;  
}  
  
// Random Function to that returns 1 with 75%  
// probability and 0 with 25% probability using  
// Bitwise OR  
function rand75() {  
    return rand50() | rand50();  
}  
  
// Driver code to test above functions  
  
// Initialize random number generator  
  
for (let i = 0; i < 50; i++)  
    document.write(rand75());
```

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```
111011111100100101100111111110111110111100011000
```

Time Complexity: $O(1)$

Auxiliary Space: $O(1)$

On similar lines, we can also use **Bitwise AND**. Since it returns 0 with 75% probability, we have to invert the result.

```
// Random Function to that returns 1 with 75%
// probability and 0 with 25% probability using
// Bitwise AND
bool rand75()
{
    return !(rand50() & rand50());
}
```

We can replace Bitwise OR and Bitwise AND operator by **OR and AND operators** as well

-

```
// Random Function to that returns 1 with 75%
// probability and 0 with 25% probability using
// OR or AND operator
int rand75()
{
    return !(rand50() && rand50());
    // return rand50() || rand50();
}
```

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```
// Program to print 1 with 75% probability and 0
// with 25% probability
#include <iostream>
using namespace std;

// Random Function to that returns 0 or 1 with
// equal probability
int rand50()
{
    // rand() function will generate odd or even
    // number with equal probability. If rand()
    // generates odd number, the function will
    // return 1 else it will return 0.
    return rand() & 1;
}

// Random Function to that returns 1 with 75%
// probability and 0 with 25% probability using
// left shift and Bitwise XOR
int rand75()
{
    // x is one of {0, 1}
    int x = rand50();

    x = x << 1;

    // x is now one of {00, 10}

    x = x ^ rand50();

    // x is now one of {00, 01, 10, 11}

    return (x > 0) ? 1 : 0;
}

// Driver code to test above functions
int main()
{
    // Initialize random number generator
```

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Java

```
// Java program to print 1 with 75% probability and 0
// with 25% probability
class GFG
{
    // Random Function to that returns 0 or 1 with
    // equal probability
    static int rand50()
    {
        // rand() function will generate odd or even
        // number with equal probability. If rand()
        // generates odd number, the function will
        // return 1 else it will return 0.
        return (int) (10 * Math.random()) & 1;
    }

    // Random Function to that returns 1 with 75%
    // probability and 0 with 25% probability using
    // left shift and Bitwise XOR
    static int rand75()
    {
        // x is one of {0, 1}
        int x = rand50();

        x = x << 1;

        // x is now one of {00, 10}

        x = x ^ rand50();

        // x is now one of {00, 01, 10, 11}

        return (x > 0) ? 1 : 0;
    }

    // Driver code
    public static void main(String[] args)
```

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PHP

```
<?php
// Program to print 1 with
// 75% probability and 0
// with 25% probability

// Random Function to that
// returns 0 or 1 with
// equal probability
function rand50()
{
    // rand() function will
    // generate odd or even
    // number with equal
    // probability. If rand()
    // generates odd number,
    // the function will return
    // 1 else it will return 0.
    return rand() & 1;
}

// Random Function to that
// returns 1 with 75%
// probability and 0 with
// 25% probability using
// left shift and Bitwise XOR
function rand75()
{
    // x is one of {0, 1}
    $x = rand50();

    $x = $x << 1;

    // x is now one
    // of {00, 10}

    $x = $x ^ rand50();
}
```

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```
// number generator
srand(time(NULL));

for ($i = 0; $i < 50; $i++)
    echo rand75();

// This code is contributed
// by ajit
?>
```

Javascript

```
<script>
// Javascript program to print 1 with 75% probability and 0
// with 25% probability

// Random Function to that returns 0 or 1 with
// equal probability
function rand50()
{
    // rand() function will generate odd or even
    // number with equal probability. If rand()
    // generates odd number, the function will
    // return 1 else it will return 0.
    return Math.floor((10 * Math.random())) & 1;
}

// Random Function to that returns 1 with 75%
// probability and 0 with 25% probability using
// Bitwise OR
function rand75()
{
    // x is one of {0, 1}
    let x = rand50();

    x = x << 1;
```

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```
// Driver code

for (let i = 0; i < 50; i++)
{
    document.write(rand75());
}

// This code is contributed by rag2127
</script>
```

Output:

0110111011101100011111111110001111011101110110110

Time Complexity: $O(1)$

Auxiliary Space: $O(1)$

Please note above solutions will produce **different results** every time we run them.

This article is contributed by **Aditya Goel**. If you like GeeksforGeeks and would like to contribute, you can also write an article using [write.geeksforgeeks.org](https://www.geeksforgeeks.org/write-geeksforgeeks/) or mail your article to review-team@geeksforgeeks.org. See your article appearing on the GeeksforGeeks main page and help other Geeks.

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