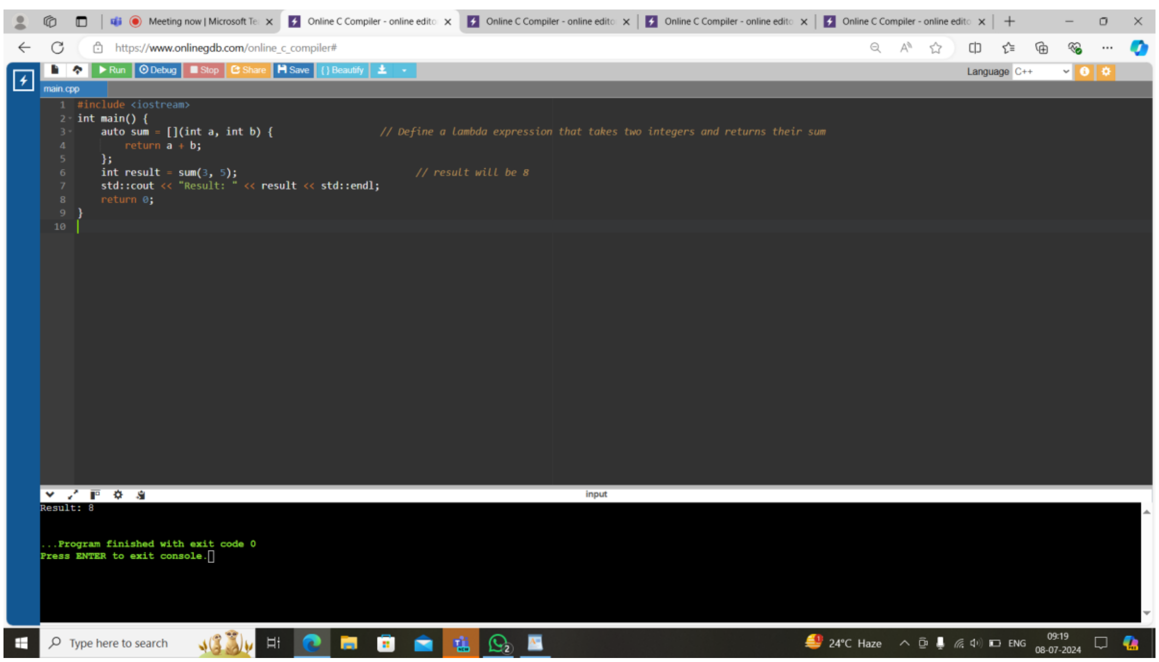
Basic Lambda: Define a lambda expression that takes two integers as arguments and returns their sum. Use auto to infer the return type.

```
#include <iostream>

int main() {

    auto sum = [](int a, int b) {                    // Define a lambda expression that takes two integers and returns their sum

        return a + b;

    };

    int result = sum(3, 5);                          // result will be 8

    std::cout << "Result: " << result << std::endl;

    return 0;

}
```

OUTPUT :-

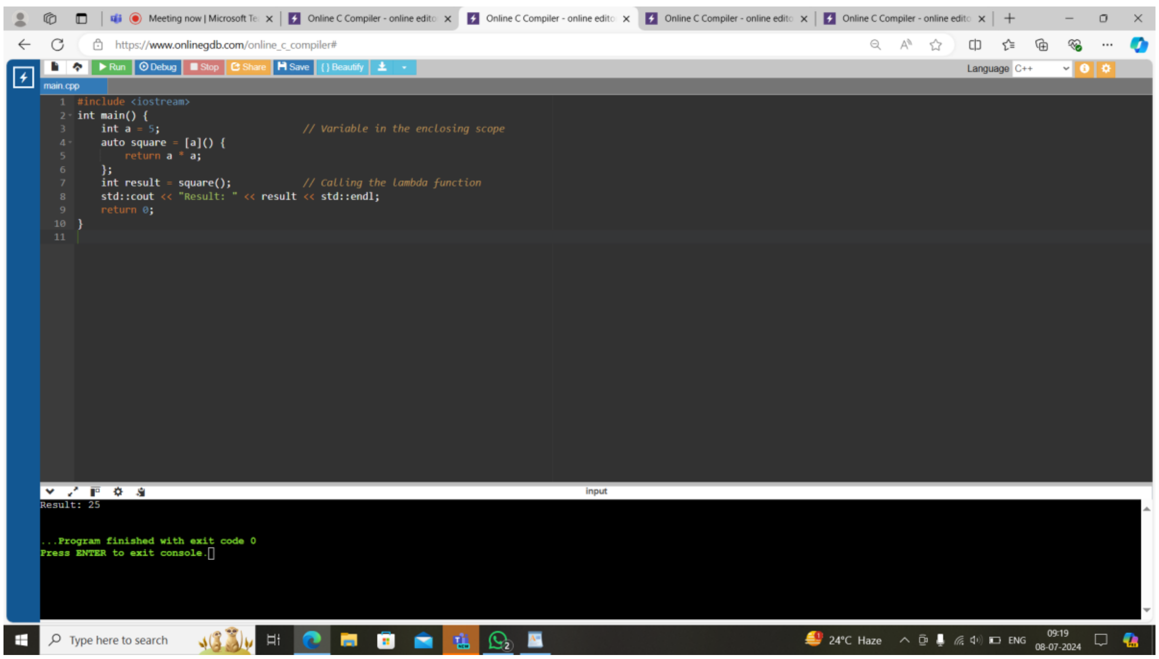


Capture by Value: Write a lambda that captures an integer by value from the enclosing scope, squares it, and returns the result.

```
#include <iostream>
```

```
int main() {
    int a = 5;                              // Variable in the enclosing scope
    auto square = [a]() {
        return a * a;
    };
    int result = square();                  // Calling the lambda function
    std::cout << "Result: " << result << std::endl;
    return 0;
}
```

OUTPUT :-

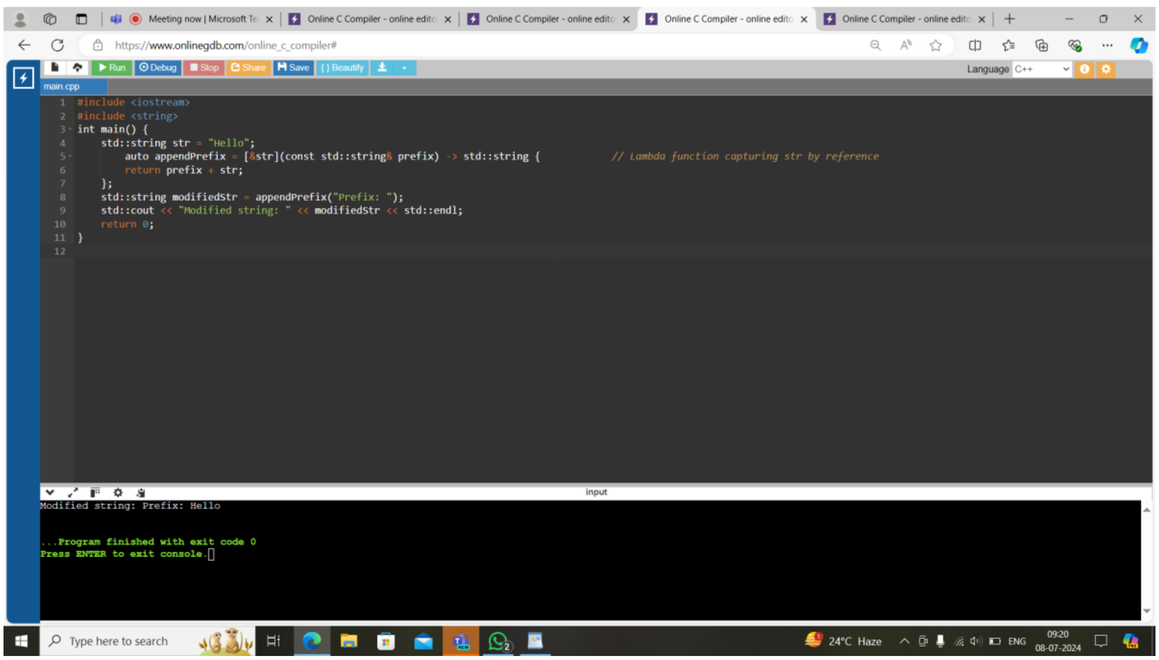


Capture by Reference: Create a lambda that captures a string by reference, appends a fixed prefix, and returns the modified string.

```
#include <iostream>

#include <string>

int main() {
```

```
    std::string str = "Hello";
        auto appendPrefix = [&str](const std::string& prefix) -> std::string {            // Lambda function capturing str by reference
        return prefix + str;
    };
    std::string modifiedStr = appendPrefix("Prefix: ");
    std::cout << "Modified string: " << modifiedStr << std::endl;
    return 0;
}
```

OUTPUT :-

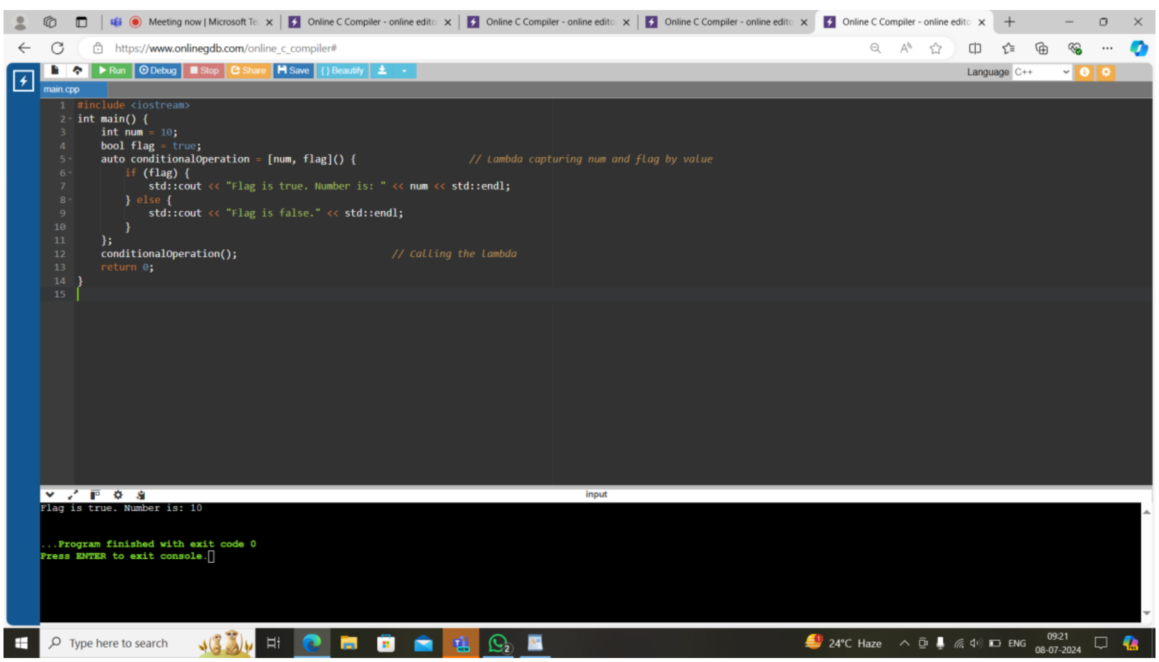


Multiple Captures: Construct a lambda that captures two variables (an integer and a boolean) by value and performs a conditional operation based on the boolean value.

```
#include <iostream>
int main() {
    int num = 10;
```

```
    bool flag = true;

    auto conditionalOperation = [num, flag]() {                    // Lambda capturing num and
flag by value

        if (flag) {

            std::cout << "Flag is true. Number is: " << num << std::endl;

        } else {

            std::cout << "Flag is false." << std::endl;

        }

    };

    conditionalOperation();                              // Calling the lambda

    return 0;

}
```

OUTPUT :-

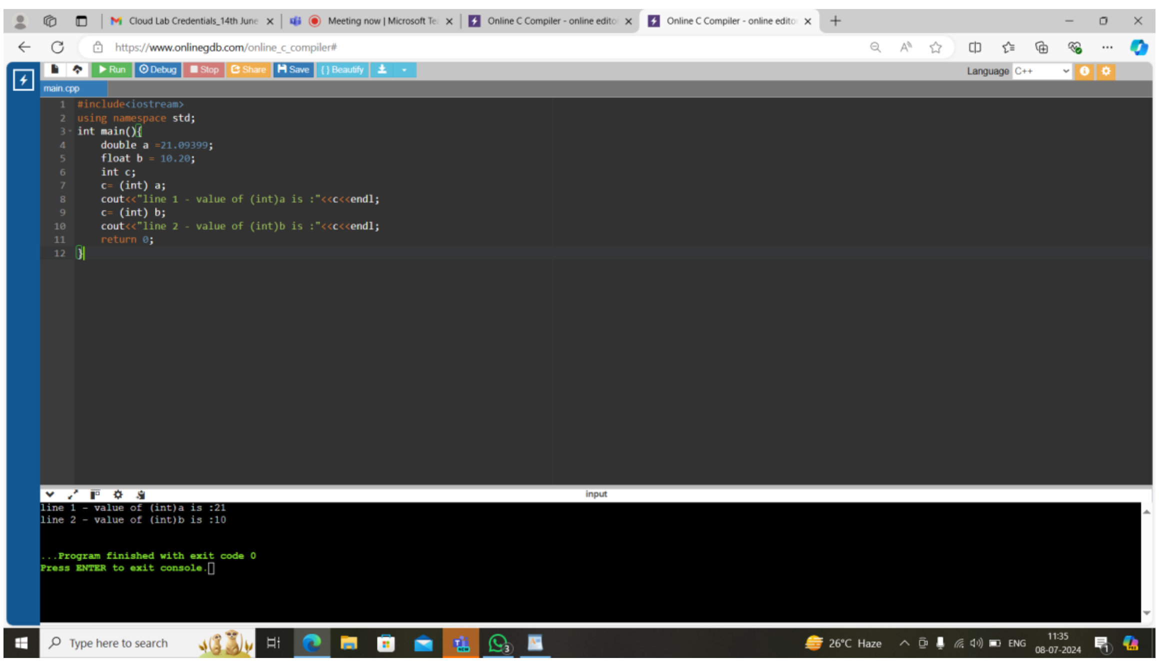


TYPE CASTING :-

```
#include<iostream>
```

```
using namespace std;

int main(){

        double a =21.09399;

        float b = 10.20;

        int c;

        c= (int) a;

        cout<<"line 1 - value of (int)a is :"<<c<<endl;

        c= (int) b;

        cout<<"line 2 - value of (int)b is :"<<c<<endl;

        return 0;

}
```

OUTPUT :-

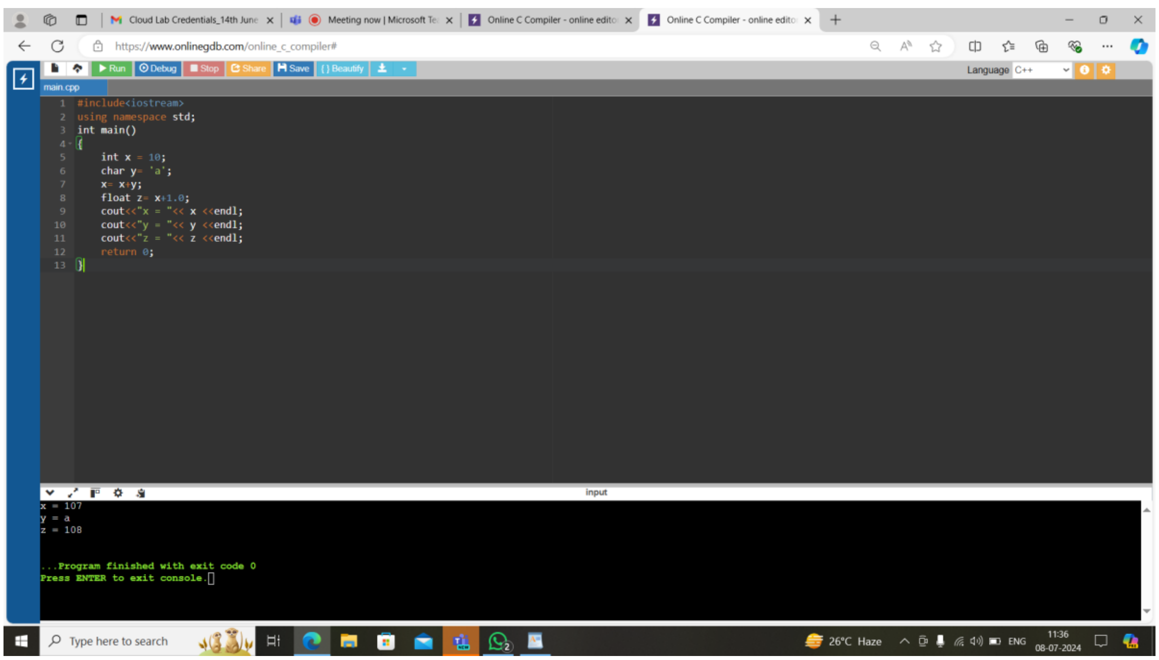


IMPLICIT TYPE CONVERSION :-

```
#include<iostream>

using namespace std;

int main()
```

```
{
	int x = 10;
	char y= 'a';
	x= x+y;
	float z= x+1.0;
	cout<<"x = "<< x <<endl;
	cout<<"y = "<< y <<endl;
	cout<<"z = "<< z <<endl;
	return 0;
}
```

OUTPUT :-

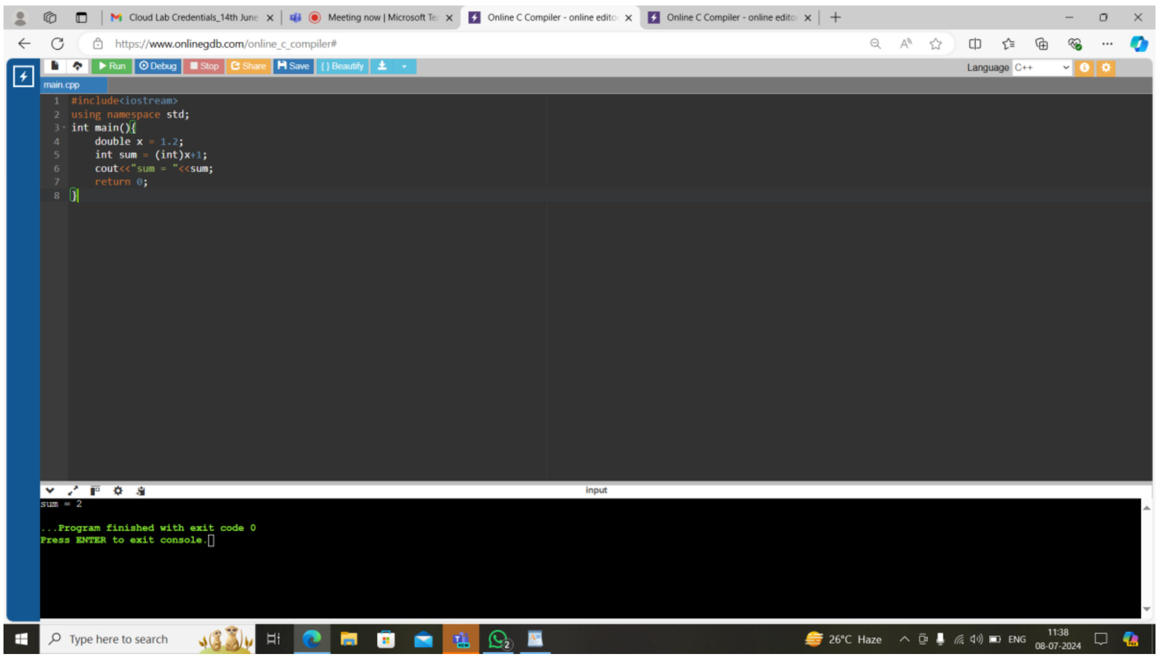


EXPLICIT TYPE CONVERSION :-

```
#include<iostream>
using namespace std;
int main(){
	double x = 1.2;
```

```
    int sum = (int)x+1;
    cout<<"sum = "<<sum;
    return 0;
}
```

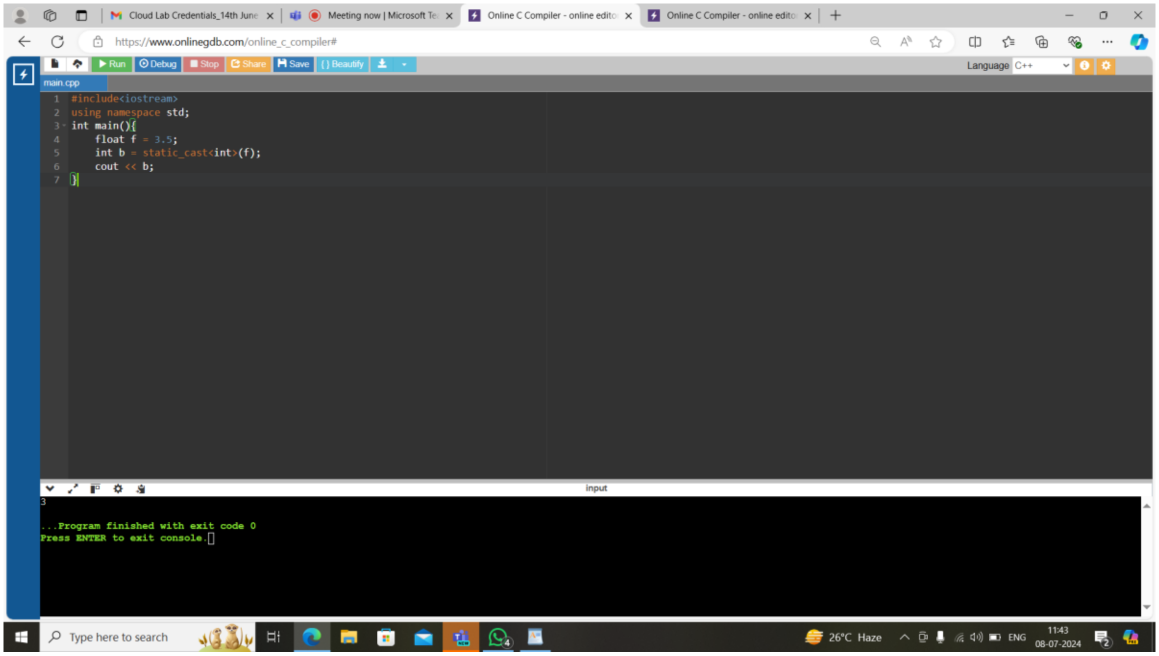
OUTPUT :-



CONVERSION USING CAST OPERATOR :-

```
#include<iostream>
using namespace std;
int main(){
    float f = 3.5;
    int b = static_cast<int>(f);
    cout << b;
}
```

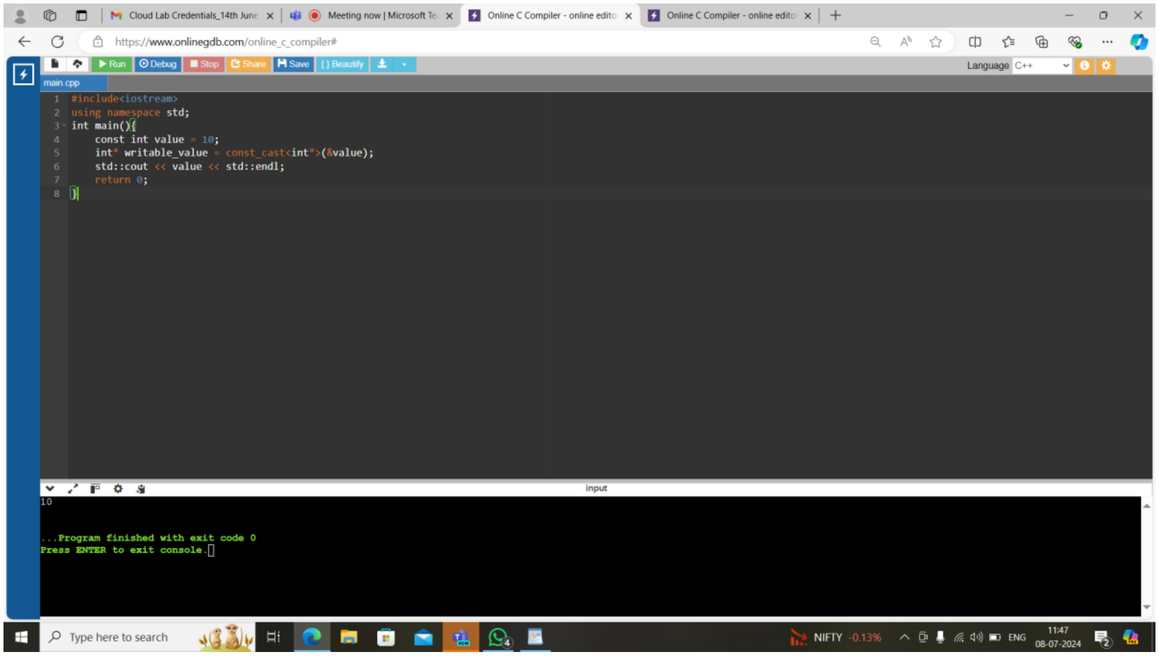
OUTPUT :-



TYPE CASTING :-

```
#include<iostream>

using namespace std;

int main(){

        const int value = 10;

        int* writable_value = const_cast<int*>(&value);

        std::cout << value << std::endl;

        return 0;

}
```

OUTPUT :-

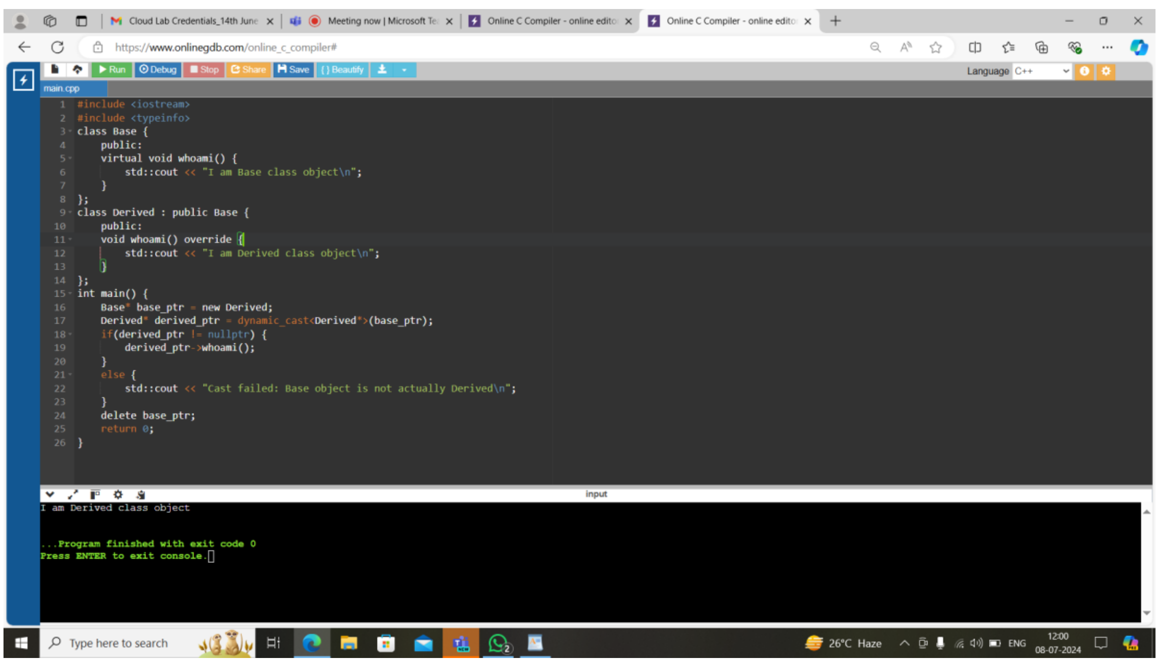


DYNAMIC CASTING :-

```
#include <iostream>

#include <typeinfo>

class Base {

    public:

    virtual void whoami() {

        std::cout << "I am Base class object\n";

    }

};

class Derived : public Base {

    public:

    void whoami() override {

        std::cout << "I am Derived class object\n";

    }

};

int main() {
```

```
	Base* base_ptr = new Derived;
	Derived* derived_ptr = dynamic_cast<Derived*>(base_ptr);
	if(derived_ptr != nullptr) {
		derived_ptr->whoami();
	}
	else {
		std::cout << "Cast failed: Base object is not actually Derived\n";
	}
	delete base_ptr;
	return 0;
}
```

OUTPUT :-

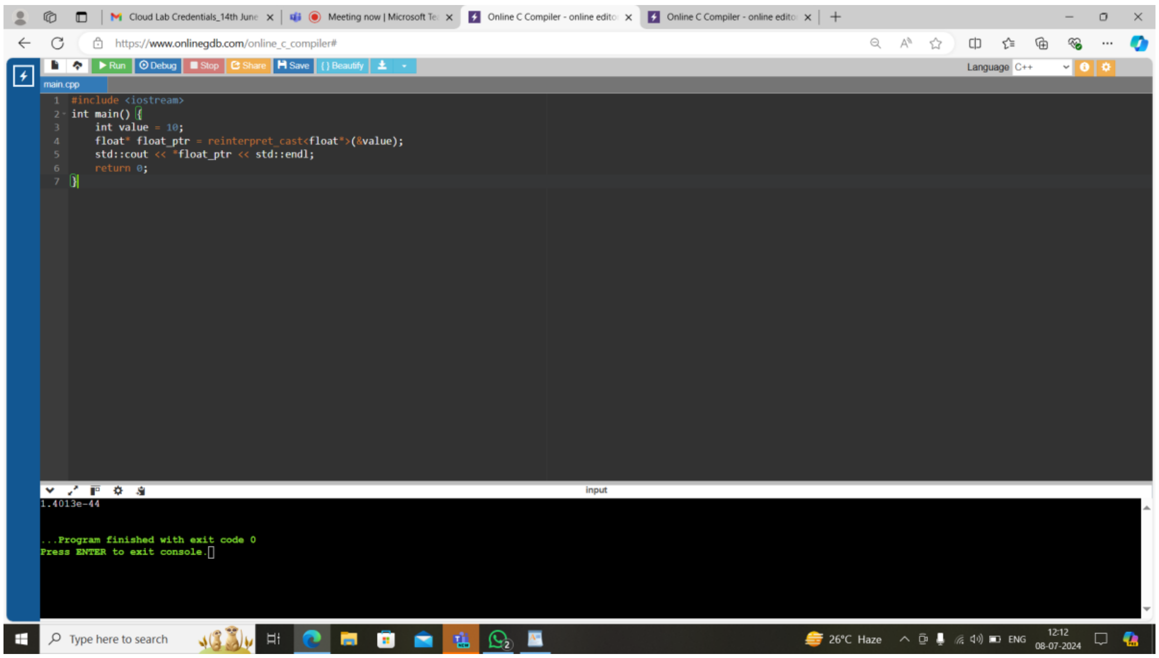


INTERPRET CASTING :-

```
#include <iostream>
int main() {
	int value = 10;
```

```
    float* float_ptr = reinterpret_cast<float*>(&value);
    std::cout << *float_ptr << std::endl;
    return 0;
}
```

OUTPUT :-



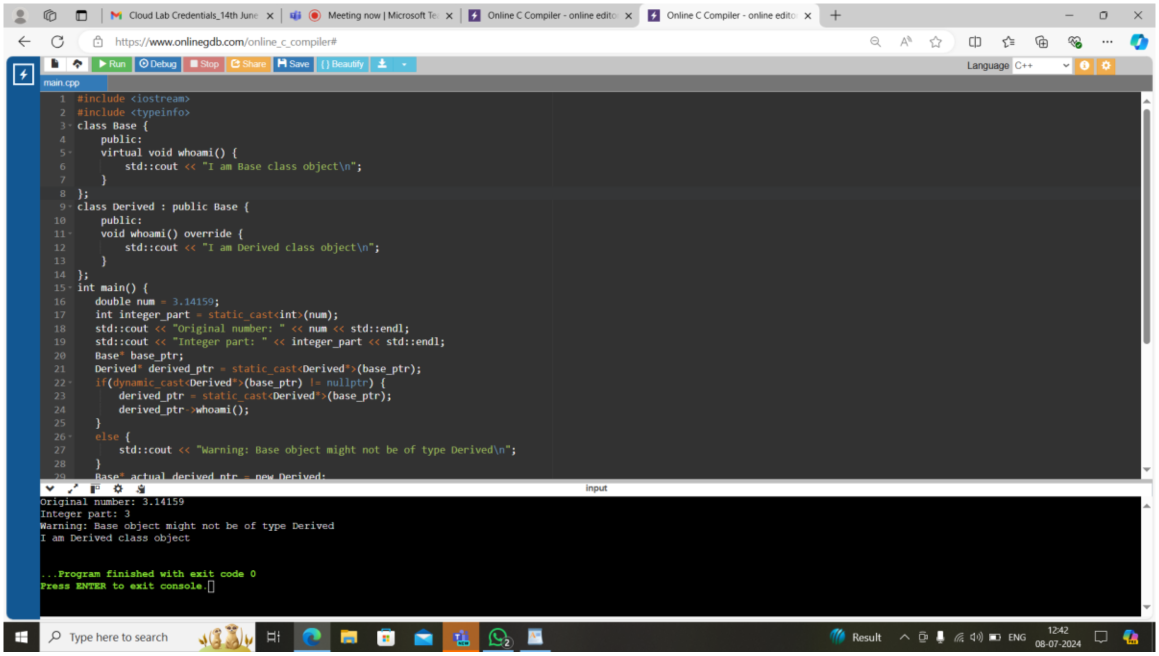
DYNAMIC TYPECASTING :-

```
#include <iostream>
#include <typeinfo>
class Base {
    public:
    virtual void whoami() {
        std::cout << "I am Base class object\n";
    }
};
class Derived : public Base {
    public:
```

```
    void whoami() override {
        std::cout << "I am Derived class object\n";
    }
};
int main() {
    double num = 3.14159;
    int integer_part = static_cast<int>(num);
    std::cout << "Original number: " << num << std::endl;
    std::cout << "Integer part: " << integer_part << std::endl;
    Base* base_ptr;
    Derived* derived_ptr = static_cast<Derived*>(base_ptr);
    if(dynamic_cast<Derived*>(base_ptr) != nullptr) {
        derived_ptr = static_cast<Derived*>(base_ptr);
        derived_ptr->whoami();
    }
    else {
        std::cout << "Warning: Base object might not be of type Derived\n";
    }
    Base* actual_derived_ptr = new Derived;
    derived_ptr = dynamic_cast<Derived*>(actual_derived_ptr);
    if(derived_ptr != nullptr) {
        derived_ptr->whoami();
    }
    else {
        std::cout << "Cast failed: Base object is not actually Derived\n";
    }
    delete actual_derived_ptr;
    int value = 10;
```

```
    float* float_ptr = reinterpret_cast<float*>(&value);

    return 0;

}
```

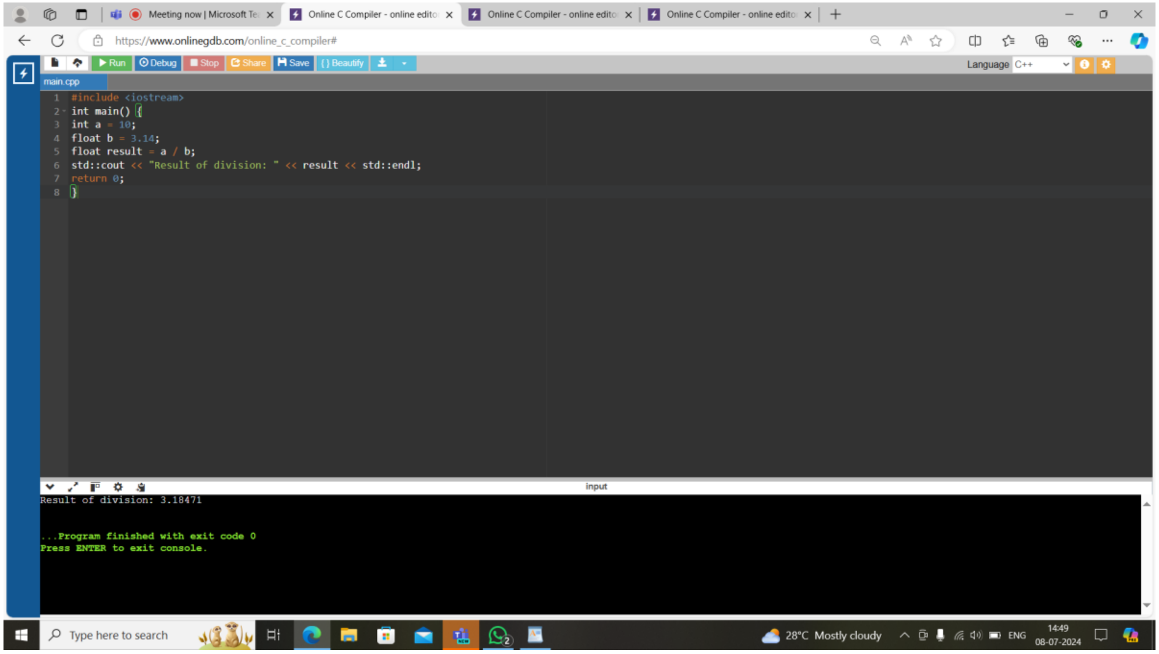
OUTPUT :-



1. Implicit Casting: Write a program that declares an int variable a with the value 10 and a float variable b with the value 3.14. Then, perform the division a / b and print the result. Explain how implicit casting works in this scenario.

```
#include <iostream>

int main() {

int a = 10;

float b = 3.14;

float result = a / b;

std::cout << "Result of division: " << result << std::endl;

return 0;

}
```

OUTPUT :-



Implicit Conversion :-

The variable a is of type int with the value 10.

The variable b is of type float with the value 3.14.

When you write a / b, the compiler sees that a is an int and b is a float.

Before performing the division, the compiler automatically converts a (which is 10) to a float. So, 10 becomes 10.0.

Then, the division 10.0 / 3.14 is performed, resulting in a float value.

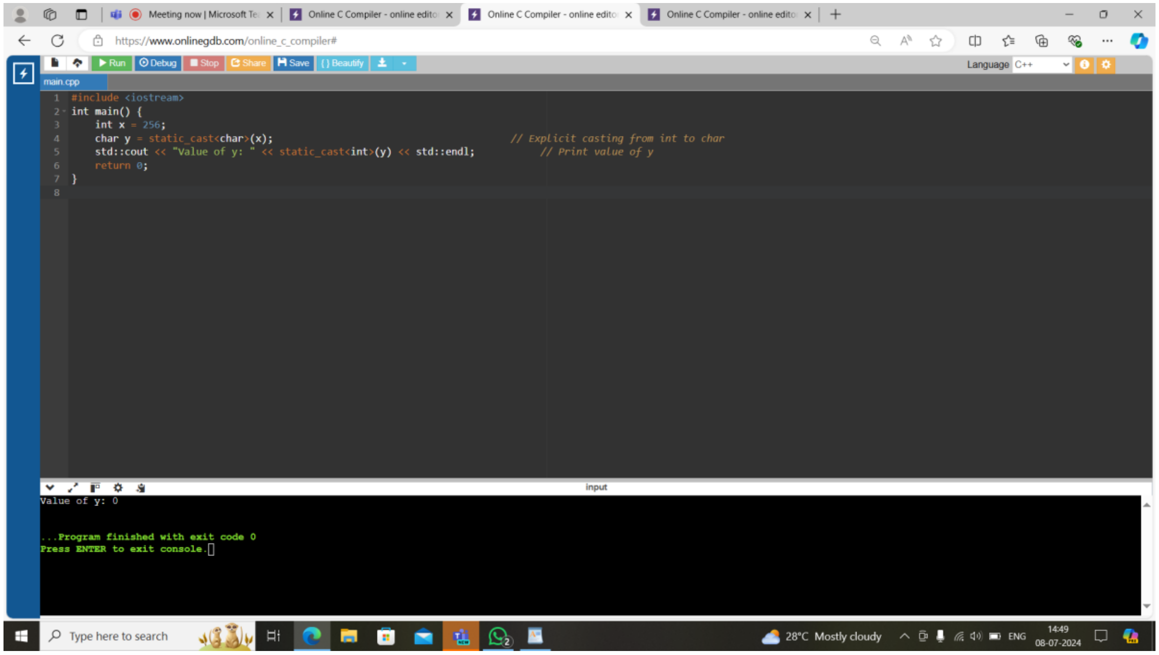
Result: The result of a / b is 10.0 / 3.14, which is approximately 3.18471.

2. Explicit Casting - Data Loss: Declare an int variable x with the value 256 and a char variable y. Assign the value of x to y using explicit casting. Print the value of y. Discuss the data loss that might occur and how to avoid it if necessary.

```
#include <iostream>

int main() {

    int x = 256;

    char y = static_cast<char>(x);                              // Explicit casting from int to char

    std::cout << "Value of y: " << static_cast<int>(y) << std::endl;          // Print value of y
```

```
    return 0;
}
```

OUTPUT :-



Understanding the Data Loss:

Value Assignment: int x = 256; assigns the value 256 to x, which is well within the range of int.

Explicit Casting: char y = static_cast<char>(x); casts the value of x (256) to a char. In C++, a char typically ranges from -128 to 127 (if signed) or 0 to 255 (if unsigned).

Data Loss: Since char is usually signed by default in most implementations, the value 256 (which is 0x100 in hexadecimal) exceeds the maximum value representable by a signed char (which is 127). Therefore, when 256 is cast to char, it undergoes what's called integer overflow and wraps around due to the limited range of char. The result of wrapping around depends on the platform's implementation, but typically it becomes 0 because of the two's complement representation.

Output: std::cout << static_cast<int>(y); will output the integer value corresponding to y. If y is 0 due to overflow, std::cout will print 0.

Avoiding Data Loss:

Check the Range: Before performing the cast, check if the value of x lies within the range of char. For a char, this would typically mean checking if x is between -128 and 127 (for signed char) or 0 to 255 (for unsigned char).

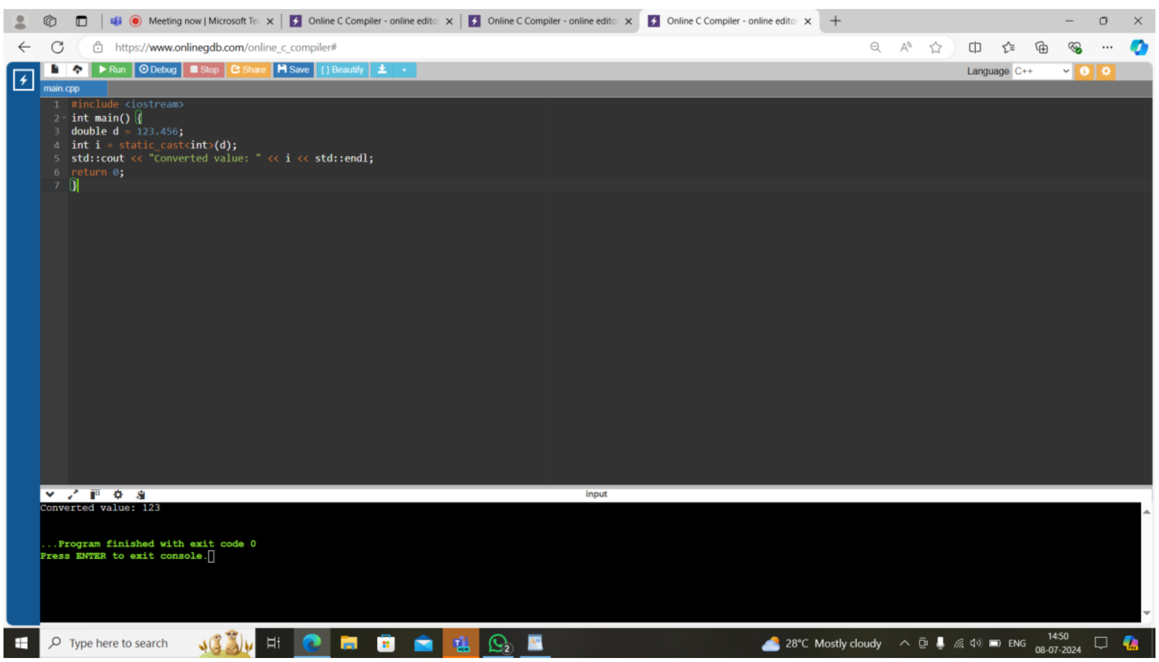
Use Conditional Logic: If x exceeds the range of char, you should handle this situation appropriately in your code. This might involve clamping the value or deciding on a default behavior based on your application's requirements.

Consider Alternative Types: If possible, reconsider whether char is the appropriate type for your needs. If you anticipate needing values outside its range, consider using a larger data type such as int or short.

3. Explicit Casting - Range Conversion: Declare a double variable d with the value 123.456. Use explicit casting to convert d to an int variable i and print i. Explain the behavior when converting from a larger range to a smaller one.

```
#include <iostream>

int main() {

double d = 123.456;

int i = static_cast<int>(d);

std::cout << "Converted value: " << i << std::endl;

return 0;

}
```

OUTPUT :-



Explanation of behavior:

Conversion Process: When you cast double d to int i using static_cast<int>(d), the compiler truncates the fractional part of d (123.456) and assigns the integer part to i.

Resulting Value: In this case, i will be assigned the value 123. This is because converting from double to int truncates towards zero; it simply drops the decimal part of the number.

Range Consideration:

Double (double): Typically holds a range of values much larger than int, and can represent both fractional and whole numbers with greater precision.

Integer (int): Has a smaller range compared to double, usually from -2147483648 to 2147483647 on most systems (32-bit integers).

Behavior with Larger to Smaller Conversion:

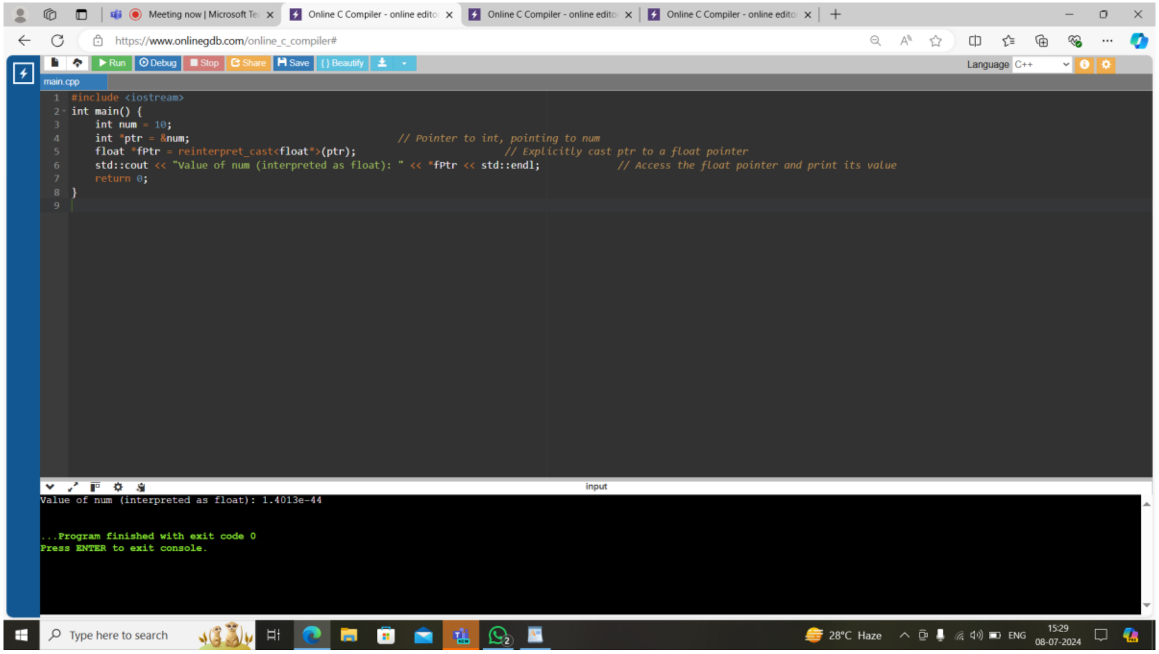
If the double value exceeds the range that can be represented by an int, the behavior is undefined in C++. This could result in unexpected values or errors depending on the compiler and system.

For values within the range of int, the conversion is straightforward, and the result is predictable

4. Casting Pointers - Same Type: Declare an int variable num and an int pointer ptr initialized with the address of num. Cast ptr to a float pointer fPtr using explicit casting. Is this casting safe? Why or why not?

```
#include <iostream>

int main() {

    int num = 10;

    int *ptr = &num;                                        // Pointer to int, pointing to num

    float *fPtr = reinterpret_cast<float*>(ptr);                            // Explicitly cast ptr to a
float pointer

    std::cout << "Value of num (interpreted as float): " << *fPtr << std::endl;                    // Access
the float pointer and print its value

    return 0;

}
```

OUTPUT :-



Is this casting safe? Why or why not?

Safety Considerations:

Type Size and Alignment: The safety of such a cast primarily depends on whether the sizes and alignments of the types involved (int and float in this case) are compatible on your system.

Strict Aliasing Rule: C++ has strict aliasing rules, which mean accessing an object through a pointer of a different type (after casting) can lead to undefined behavior if the types are not compatible.

Specific Issues:

Representation Difference: int and float typically have different representations in memory. Casting an int * to float * assumes that the memory layout and size of an int are compatible with that of a float, which is not always guaranteed.

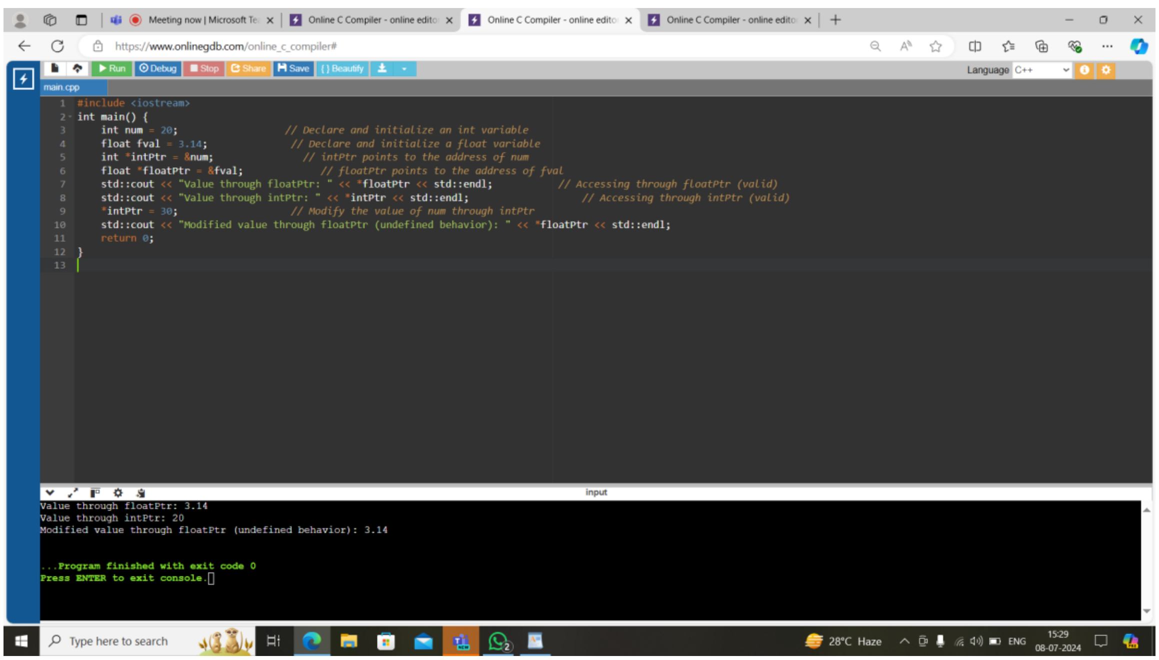
Alignment: The alignment requirements for int and float might differ. For example, on some systems, int might be aligned on a 4-byte boundary whereas float might require 8-byte alignment. Improper alignment can cause alignment faults or undefined behavior.

5. Casting Pointers - Different Types: Declare an int variable num and a float variable fval. Initialize an int pointer intPtr with the address of num and a float pointer floatPtr with the address of fval. Can you safely cast intPtr to floatPtr? Explain.

```
#include <iostream>

int main() {

    int num = 20;                        // Declare and initialize an int variable
```

```
    float fval = 3.14;                  // Declare and initialize a float variable

    int *intPtr = &num;                 // intPtr points to the address of num

    float *floatPtr = &fval;            // floatPtr points to the address of fval

    std::cout << "Value through floatPtr: " << *floatPtr << std::endl;          // Accessing through floatPtr (valid)

    std::cout << "Value through intPtr: " << *intPtr << std::endl;          // Accessing through intPtr (valid)

    *intPtr = 30;                       // Modify the value of num through intPtr

    std::cout << "Modified value through floatPtr (undefined behavior): " << *floatPtr << std::endl;

    return 0;

}
```

OUTPUT :-



Can you safely cast intPtr to floatPtr?

No, you cannot safely cast intPtr to floatPtr in C++.

Explanation:

Memory Representation and Alignment:

int and float typically have different sizes and representations in memory. For instance, an int might be 4 bytes (32 bits) and a float might also be 4 bytes (32 bits), but they are stored differently (integer vs floating-point representation).

Casting intPtr to floatPtr assumes that the memory layout and interpretation for an int can be directly used as a float, which is incorrect. The internal representation of an int and a float are different due to how each type stores and interprets its bits.

Strict Aliasing Rule:

In C++, there's a strict aliasing rule which dictates that you cannot safely access an object of one type through a pointer of another type, except for certain specific cases (like accessing char* through another type's pointer). Violating this rule can lead to undefined behavior.

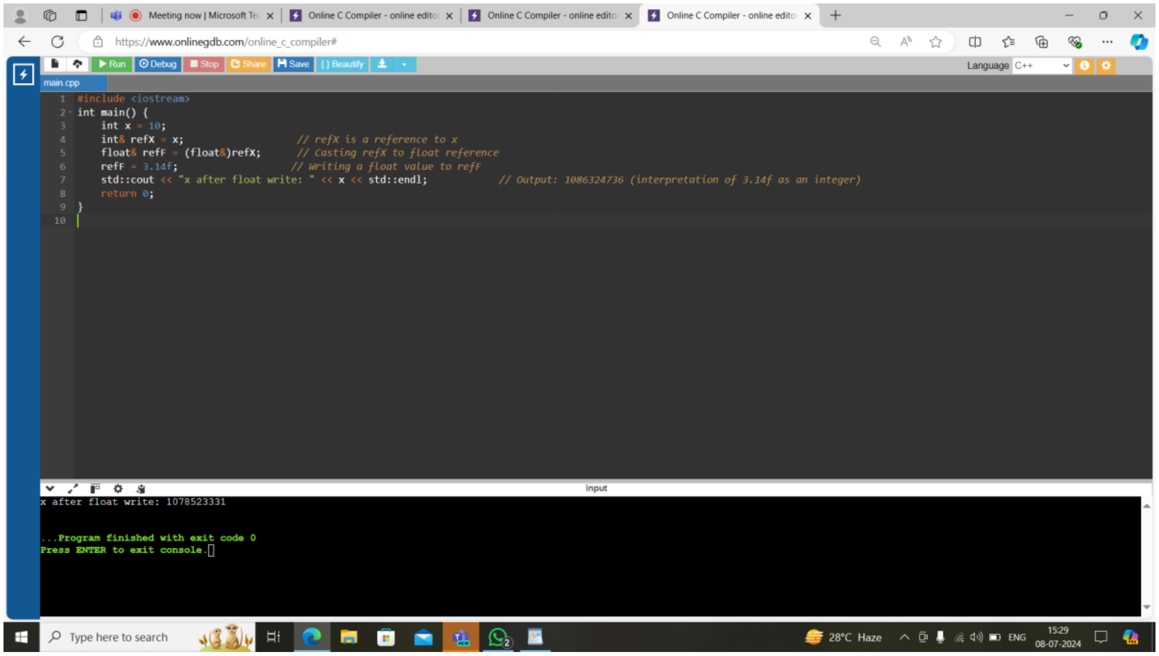
Potential Consequences:

If you were to cast intPtr to floatPtr and then dereference floatPtr to read or modify the float value, you would interpret the memory of num (which holds an int) as if it were a float. This misinterpretation can lead to incorrect results or crashes, depending on the underlying representation and alignment requirements.

6. Casting References - Same Type: Declare an int variable x and an int reference refX assigned to x. Cast refX to a float reference refF. What happens in this case?

```
#include <iostream>

int main() {

    int x = 10;

    int& refX = x;                     // refX is a reference to x

    float& refF = (float&)refX;        // Casting refX to float reference

    refF = 3.14f;                      // Writing a float value to refF

    std::cout << "x after float write: " << x << std::endl;          // Output: 1086324736
(interpretation of 3.14f as an integer)

    return 0;

}
```

OUTPUT :-



What happens in this case:

Type Reinterpretation: The reinterpret_cast<float&>(refX) attempts to reinterpret the reference refX, which is originally an int reference, as a float reference (refF).

Memory Interpretation: This operation does not change the actual value stored in x or refX; instead, it changes how the compiler views that memory when accessed through refF. It essentially tells the compiler to treat the bits representing the integer as if they were a floating-point number.

Potential Issues:

Undefined Behavior: The C++ standard does not define the exact behavior of accessing an int as a float (or vice versa) through reinterpretation casts like this. Different compilers may handle this situation differently.

Compatibility: This approach assumes that the representation of an int and a float are compatible in terms of memory layout, which is generally not guaranteed across different platforms and compilers.

Use Cases:

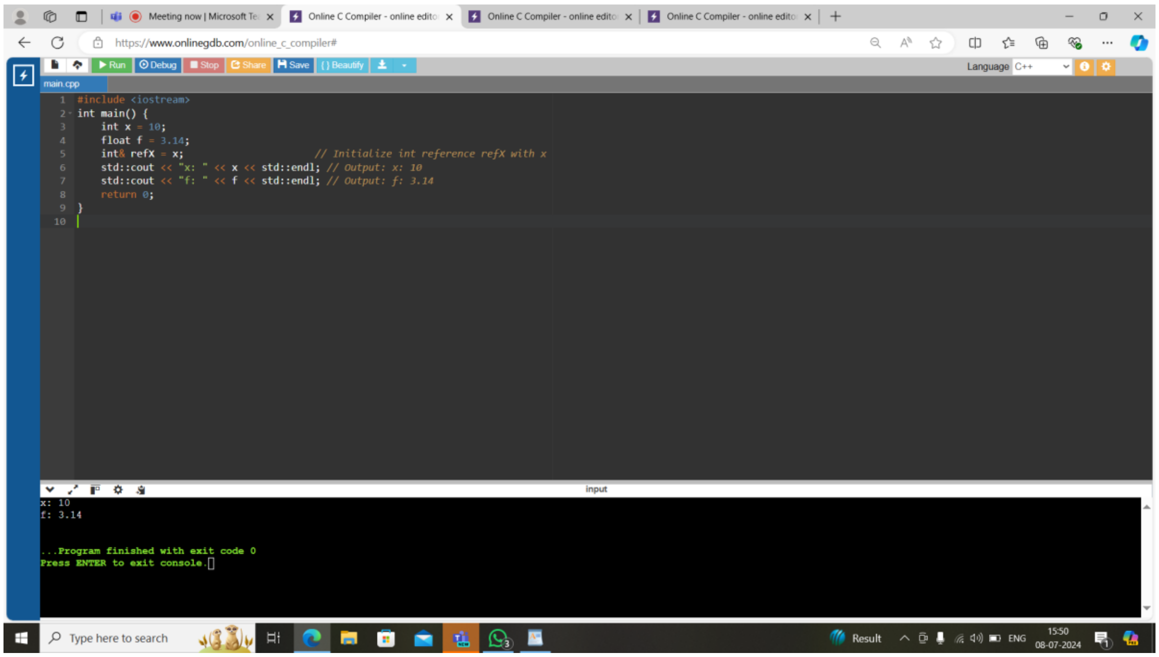
Low-level Memory Manipulation: Reinterpretation casts are typically used in low-level programming or specific optimization scenarios where you need to access the same memory in different ways (e.g., for type punning or accessing union members).

7. Casting References - Different Types: Declare an int variable x and a float variable f. Initialize an int reference refX with x. Can you cast refX to refer to f? Why or why not?

```
#include <iostream>

int main() {
```

```
int x = 10;

float f = 3.14;

int& refX = x;                                   // Initialize int reference refX with x

std::cout << "x: " << x << std::endl; // Output: x: 10

std::cout << "f: " << f << std::endl; // Output: f: 3.14

return 0;

}
```

OUTPUT :-



No, you cannot cast refX to refer to f.

In C++, once a reference is initialized to refer to a particular variable type (in this case, int), it cannot be re-bound to refer to a different type (such as float). This is because references are essentially aliases for existing objects, and their type is fixed once they are initialized.

Here's a breakdown of why you cannot cast refX to refer to f:

Type Compatibility: refX is initialized as an int&, meaning it can only refer to an int variable (x in this case). It cannot directly refer to a float variable (f).

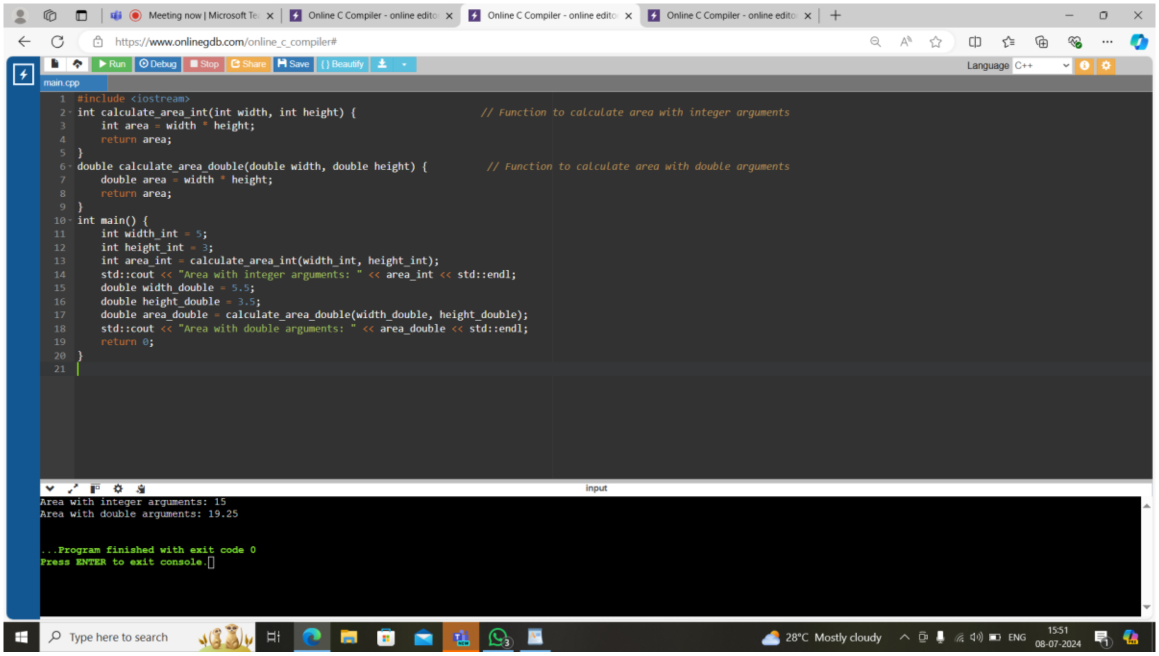
No Implicit Conversion: C++ does not allow implicit conversions between different types of references. Even though int and float might have the same storage size or similar characteristics, the language requires explicit type matching for references.

Type Safety: Allowing such casts would violate type safety principles in C++, where the type of a reference is meant to be strictly adhered to once initialized. Casting refX to float& would potentially lead to undefined behavior or data corruption, as refX was not initialized to refer to a float.

8. Challenge: Area Calculation (Implicit vs. Explicit): Write two functions to calculate the area of a rectangle. One function should take two int arguments for width and height and return an int area. The other function should take two double arguments and return a double area. Discuss the implications of using implicit and explicit casting in these functions.

```
#include <iostream>

int calculate_area_int(int width, int height) {                    // Function to calculate area with integer arguments

    int area = width * height;

    return area;

}

double calculate_area_double(double width, double height) {              // Function to calculate area with double arguments

    double area = width * height;

    return area;

}

int main() {

    int width_int = 5;

    int height_int = 3;

    int area_int = calculate_area_int(width_int, height_int);

    std::cout << "Area with integer arguments: " << area_int << std::endl;

    double width_double = 5.5;

    double height_double = 3.5;

    double area_double = calculate_area_double(width_double, height_double);

    std::cout << "Area with double arguments: " << area_double << std::endl;

    return 0;

}
```

OUTPUT :-



Implications of Implicit and Explicit Casting

Implicit Casting: This occurs when the programming language automatically converts data from one type to another without requiring explicit instructions from the programmer.

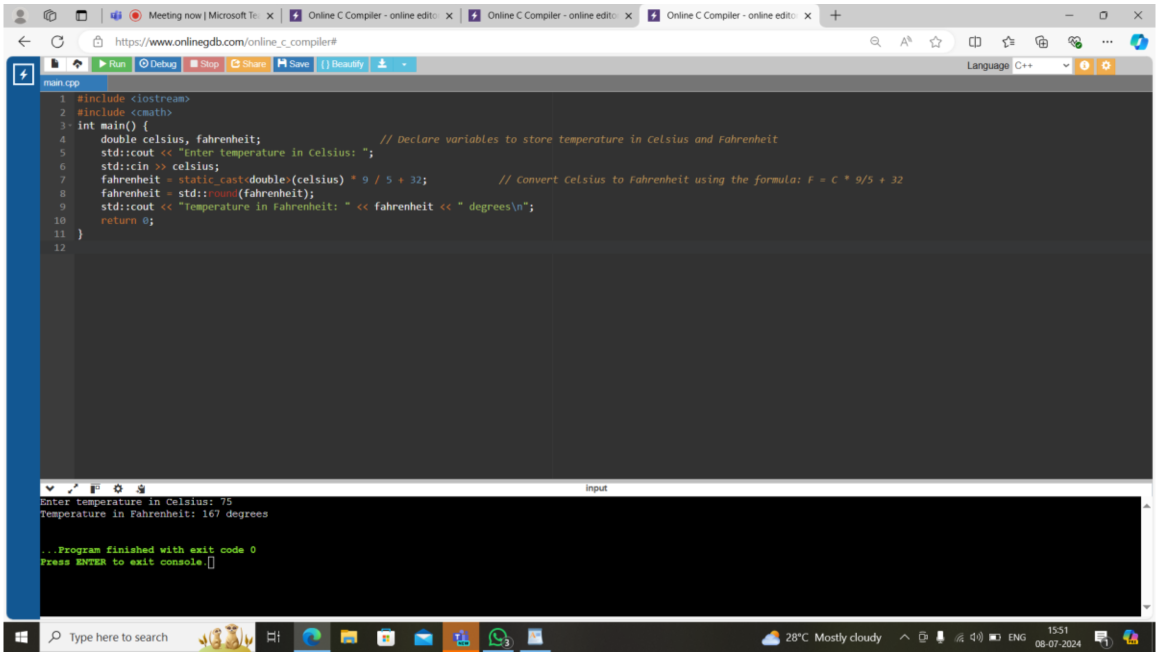
Explicit Casting: This involves the programmer explicitly converting data from one type to another.

9. Challenge: Temperature Conversion (Casting and Rounding): Create a program that takes a temperature in Celsius as input from the user. Use explicit casting and appropriate rounding techniques to convert it to Fahrenheit and print the result.

```
#include <iostream>

#include <cmath>

int main() {

    double celsius, fahrenheit;                          // Declare variables to store temperature in Celsius and Fahrenheit

    std::cout << "Enter temperature in Celsius: ";

    std::cin >> celsius;

    fahrenheit = static_cast<double>(celsius) * 9 / 5 + 32;                    // Convert Celsius to Fahrenheit using the formula: F = C * 9/5 + 32

    fahrenheit = std::round(fahrenheit);

    std::cout << "Temperature in Fahrenheit: " << fahrenheit << " degrees\n";
```

```
    return 0;

}
```

OUTPUT :-



Explicit Casting: The static_cast<double>(celsius) explicitly casts celsius to double to ensure that the multiplication and division operations yield a double result, preserving precision.

Rounding: The std::round function is used to round the double result of the Fahrenheit calculation to the nearest whole number before printing.

Include Directive: The <cmath> header is included for the std::round function used for rounding the Fahrenheit temperature.

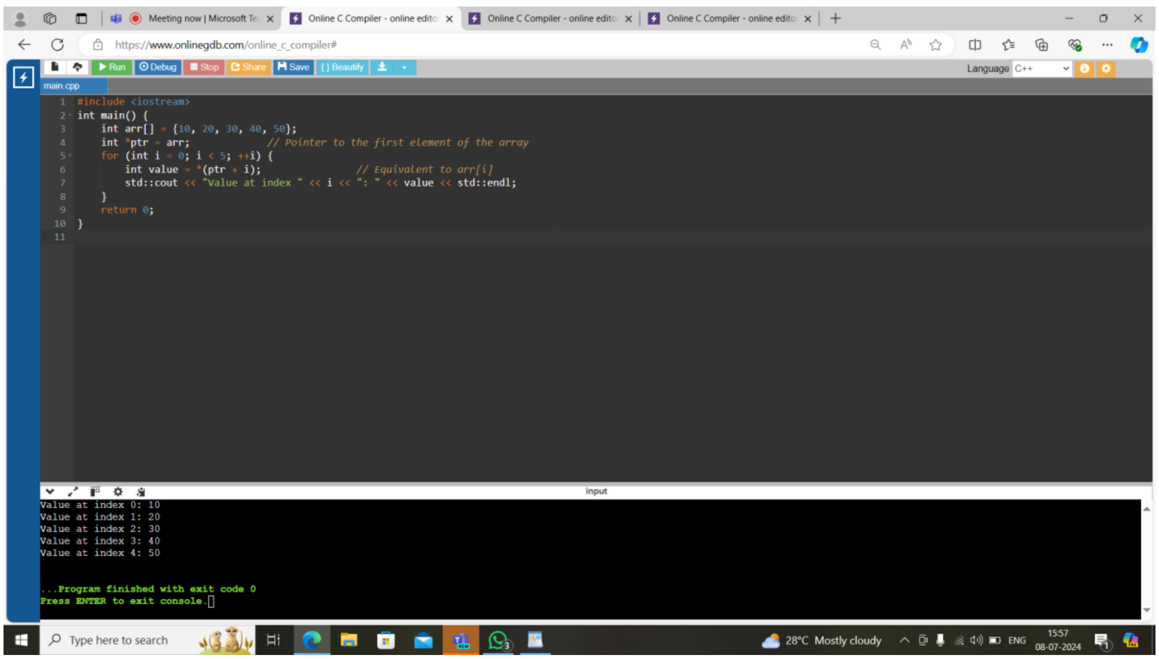
10. Challenge: Pointer Arithmetic with Casting (Safe vs. Unsafe): Demonstrate safe and unsafe pointer arithmetic with casting. Explain the potential consequences of unsafe pointer manipulation.

Safe Pointer Arithmetic with Casting :

```
#include <iostream>

int main() {

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

```
    int *ptr = arr;                    // Pointer to the first element of the array
    for (int i = 0; i < 5; ++i) {
        int value = *(ptr + i);                    // Equivalent to arr[i]
        std::cout << "Value at index " << i << ": " << value << std::endl;
    }
    return 0;
}
```

OUTPUT :-

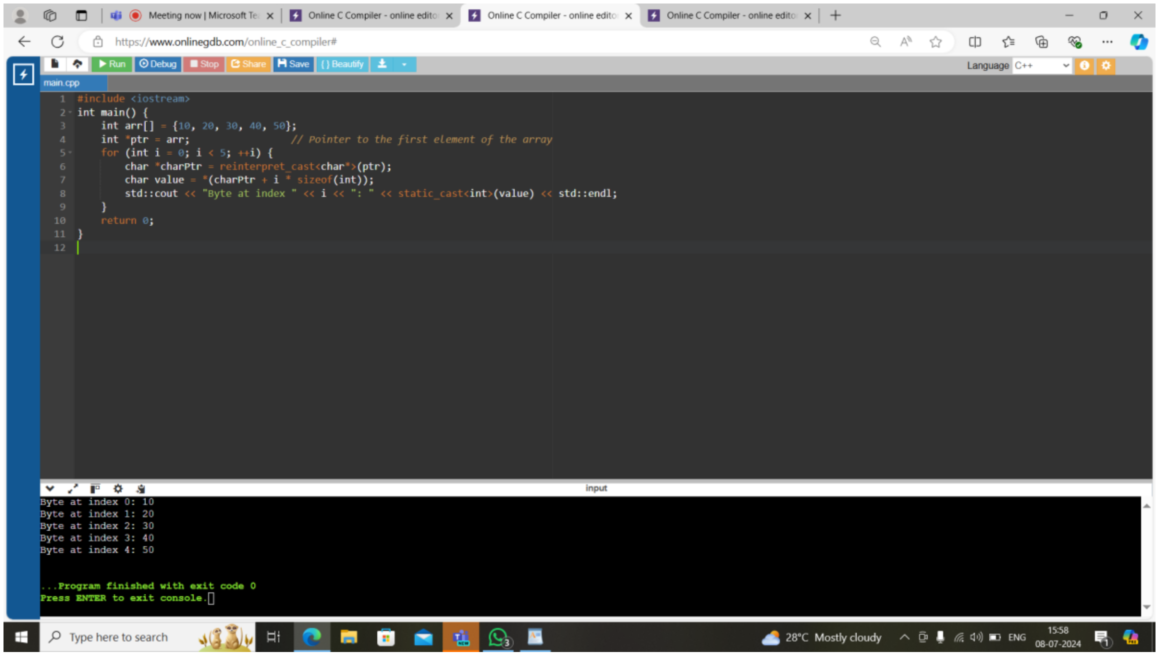


Unsafe Pointer Arithmetic with Casting

```
#include <iostream>
int main() {
    int arr[] = {10, 20, 30, 40, 50};
    int *ptr = arr;                    // Pointer to the first element of the array
    for (int i = 0; i < 5; ++i) {
        char *charPtr = reinterpret_cast<char*>(ptr);
        char value = *(charPtr + i * sizeof(int));
        std::cout << "Byte at index " << i << ": " << static_cast<int>(value) << std::endl;
```

```
    }
    return 0;
}
```

OUTPUT :-



Potential Consequences of Unsafe Pointer Manipulation :-

Undefined Behavior: Incorrect pointer arithmetic or casting can result in undefined behavior. This means the program's behavior is unpredictable and may vary between different compilers, platforms, or even different runs on the same system.

Memory Corruption: Accessing memory out of bounds or with an incorrect type can corrupt memory. This can lead to crashes or data corruption, which are difficult to debug.

Security Vulnerabilities: Incorrect pointer manipulation can introduce security vulnerabilities such as buffer overflows or injection attacks. This is especially critical in systems handling sensitive data or running in environments where security is paramount.

Platform Dependence: Pointer behavior can differ across different hardware architectures or compilers. Code that works on one platform may behave differently or fail on another.

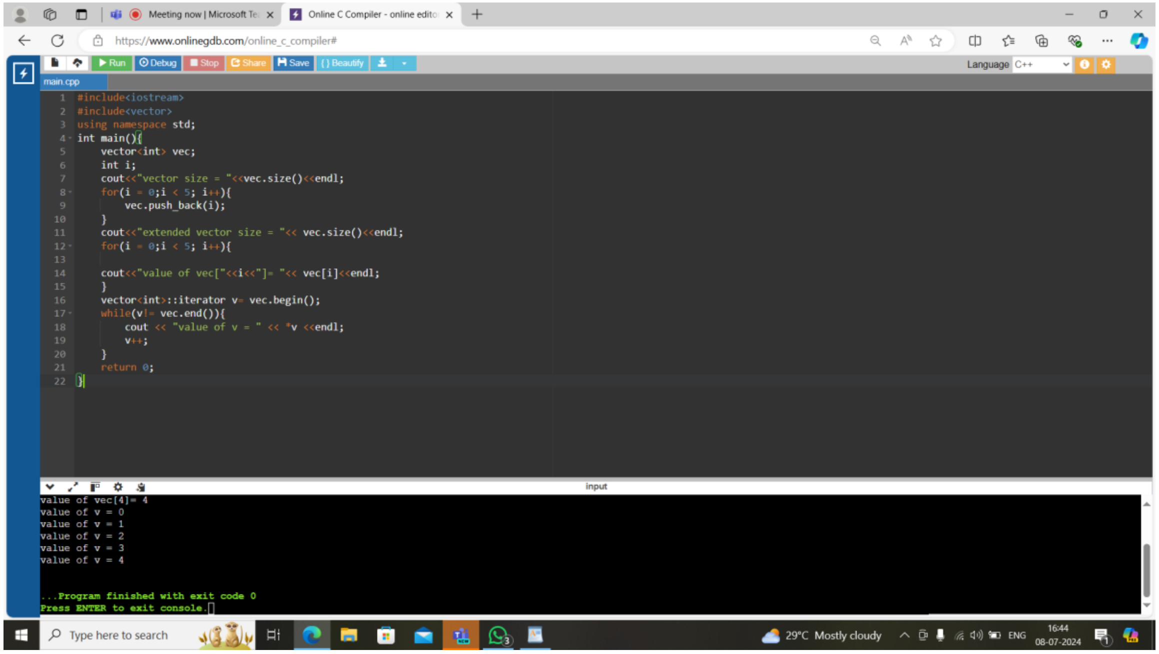
VECTOR :-

#include<iostream>

#include<vector>

```
using namespace std;

int main(){

        vector<int> vec;

        int i;

        cout<<"vector size = "<<vec.size()<<endl;

        for(i = 0;i < 5; i++){

                vec.push_back(i);

        }

        cout<<"extended vector size = "<< vec.size()<<endl;

        for(i = 0;i < 5; i++){


        cout<<"value of vec["<<i<<"]= "<< vec[i]<<endl;

        }

        vector<int>::iterator v= vec.begin();

        while(v!= vec.end()){

                cout << "value of v = " << *v <<endl;

                v++;

        }

        return 0;

}
```

OUTPUT :-


Meeting now | Microsoft Te
Online C Compiler - online edito
https://www.onlinegdb.com/online_c_compiler#
Run
Debug
Stop
Share
Save
{ } Beautify
Language C++
main.cpp
#include<iostream>
#include<vector>
using namespace std;
int main(){
vector<int> vec;
int i;
cout<<"vector size = "<<vec.size()<<endl;
for(i = 0;i < 5; i++){
vec.push_back(i);
}
cout<<"extended vector size = "<< vec.size()<<endl;
for(i = 0;i < 5; i++){
cout<<"value of vec["<<i<<"]= "<< vec[i]<<endl;
}
vector<int>::iterator v= vec.begin();
while(v!= vec.end()){
cout << "value of v = " << *v <<endl;
v++;
}
return 0;
}
input
value of vec[4]= 4
value of v = 0
value of v = 1
value of v = 2
value of v = 3
value of v = 4
...Program finished with exit code 0
Press ENTER to exit console.
Type here to search
29°C Mostly cloudy
ENG
16:44
08-07-2024