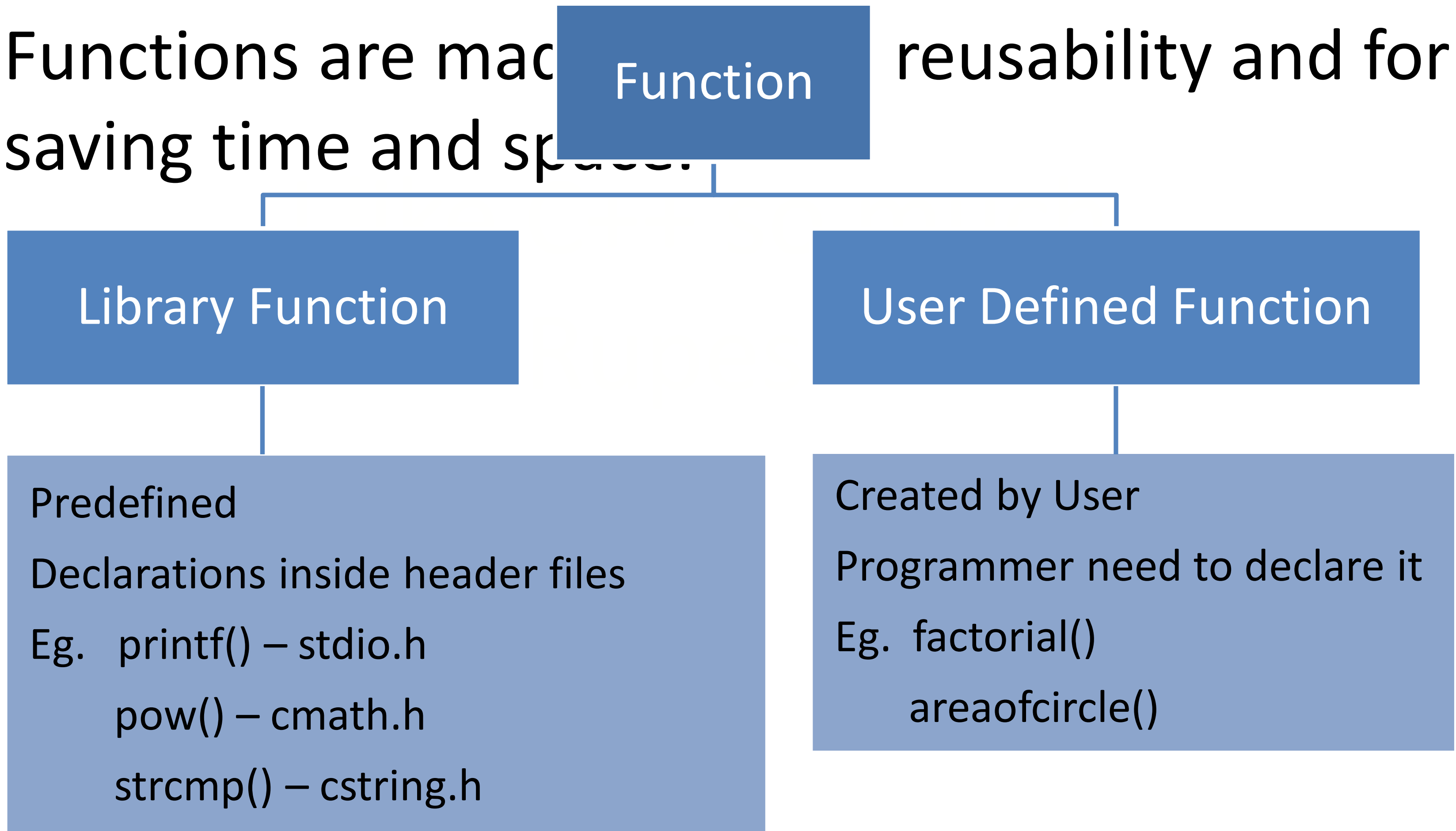
C++ Functions

C++ Function

- A **function** is a group of statements that together perform a task.
- Functions are mac reusability and for saving time and sp



C++ Function – (Cont…)

- There are three elements of user defined function

```
void func1();
void main()
{
   ....
   func1();
}
void func1()
{
   ....
   ....
}
```

Function Declaration

Function call

Function body

Function definition

Simple Function – (Cont…)

- **Function Declaration**

  Syntax:

```
return-type function-name (arg-1, arg 2, …);
```

  Example:
```
int addition(int , int );
```

- **Function Definition**

  Syntax:

```
return-type function-name (arg-1, arg 2, …)
{
     ... Function body
}
```

  Example:
```
int addition(int x, int y)
{
     return x+y;
}
```

Categories of Function

(1) Function **with arguments** and **returns** value

Function arguments/ parameters

Return type

```
int func1(int , int ); \\declaration
void main()
{
   ....
   int z = func1(5,6); \\function call
}
int func1(int a, int b) \\definition
{
   ....
   return a+b;
}
```

Function func1 returns integer value to variable z

returns a+b to calling function

Categories of Function (Cont...)

(2) Function **with arguments** but **no return** value

```
void func1(int , int ); \\function declaration
void main()
{
   ....
   func1(5,6); \\function call
}
void func1(int a, int b) \\function definition
{
   ....
   ....
}
```

Categories of Function (Cont..)

(3) Function with **no argument** but **returns** value

```
int func1();
void main()
{
   ....
   int z = func1();
}
int func1()
{
   ....
   return 99;
}
```

Categories of Function (Cont...)

(4) Function **with no argument** and **no return** value

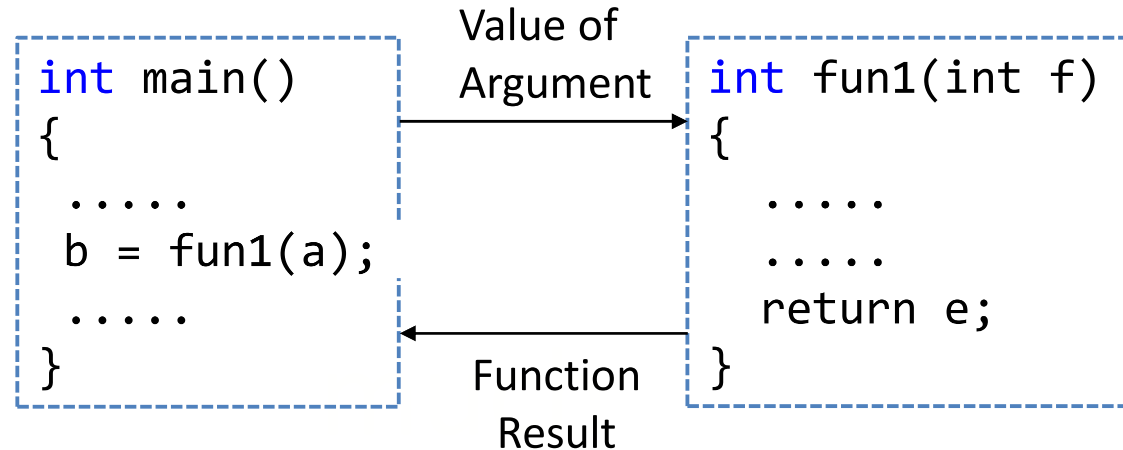
```
void func1();
void main()
{
   ....
     func1();
}
void func1()
{
   ....
   ....
}
```

Program: Categories of function

- Write C++ programs to demonstrate various categories of function, Create function **addition** for all categories.

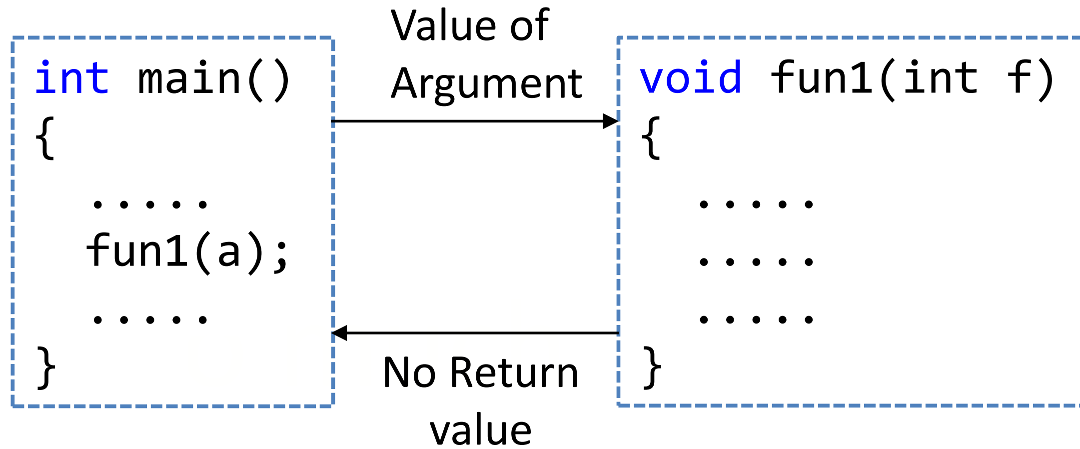
Function with argument and returns value

```
#include <iostream>
using namespace std;

int add(int, int);

int main(){
  int a=5,b=6,ans;
  ans = add(a,b);
  cout<<"Addition is="<<ans;
  return 0;
}
int add(int x,int y)
{
  return x+y;
}
```



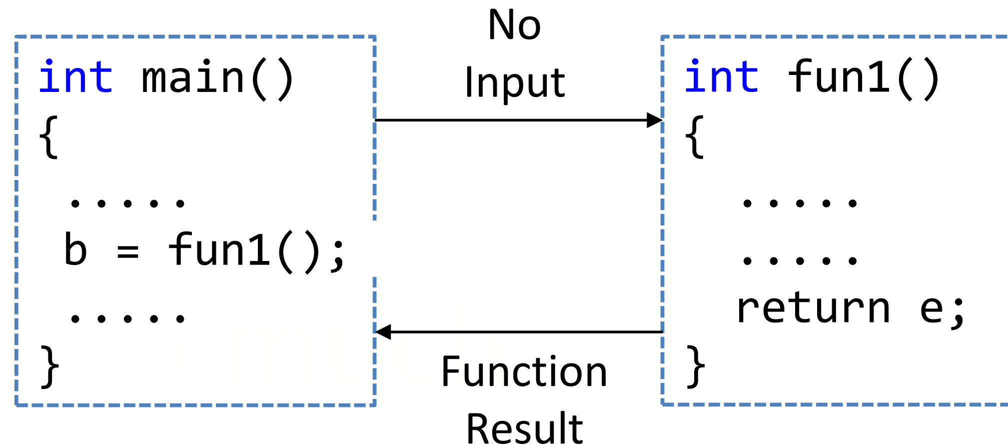
Function with arguments but no return value

```
#include <iostream>
using namespace std;

void add(int, int);
int main()
{
   int a=5,b=6;
   add(a,b);
   return 0;
}
void add(int x,int y)
{
 cout<<"Addition is="<<x+y;
}
```



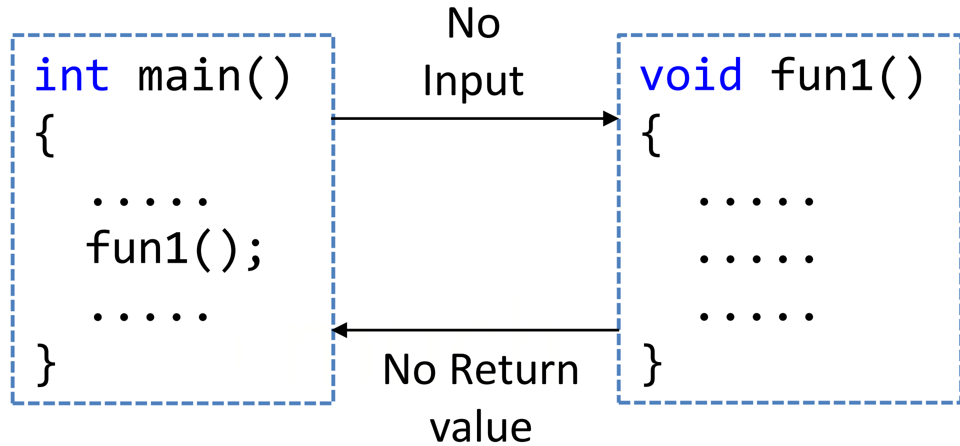
Function with no argument but returns value

```
int add();

int main()
{
   int ans;
   ans = add();
   cout<<"Addition is="<<ans;
   return 0;
}
void add()
{
   int a=5,b=6;
   return a+b;
}
```



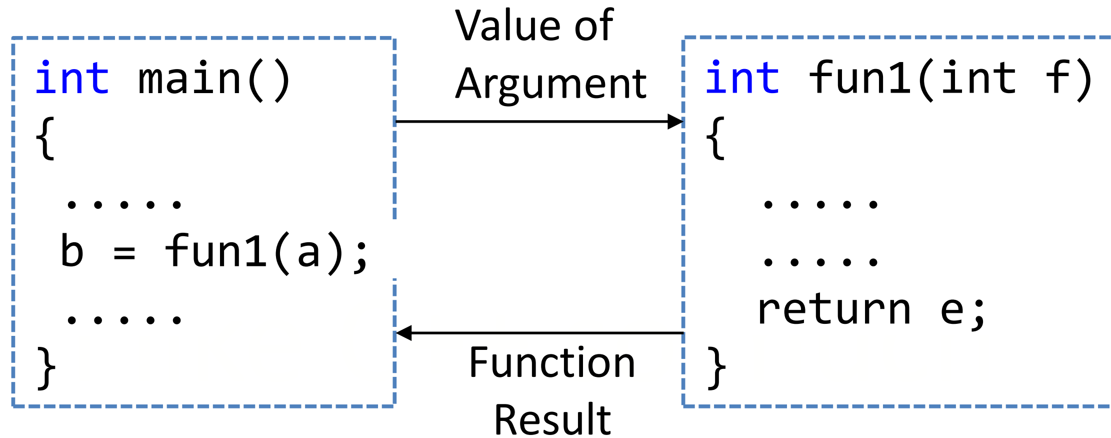
Function with no argument and no return value

```
void add();

int main()
{
  add();
  return 0;
}
void add()
{
  int a=5,b=6;
  cout<<"Addition is="<<a+b;
}
```

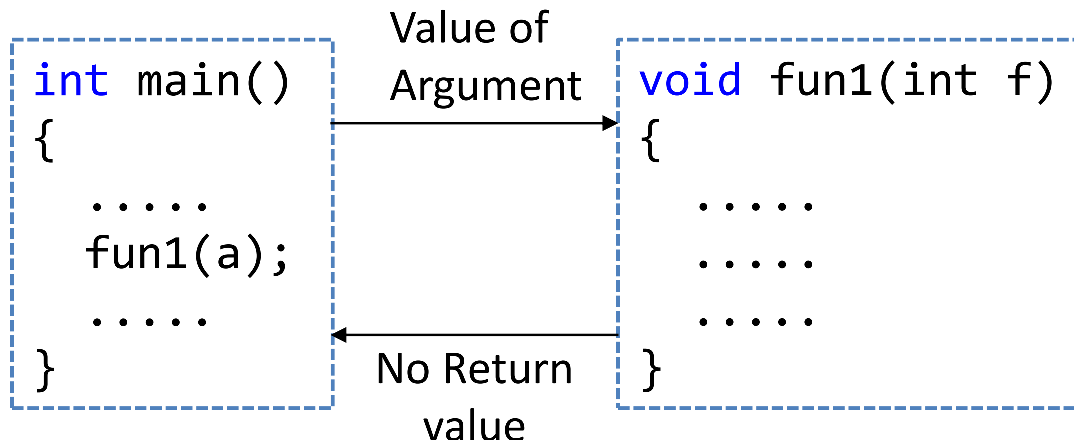


Categories of Functions Summary

(1) Function with argument and returns value

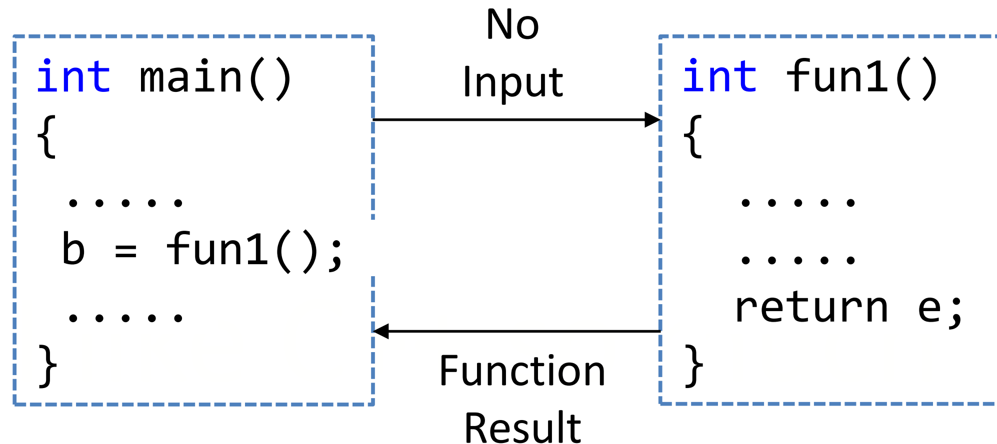


(2) Function with argument and but no return value

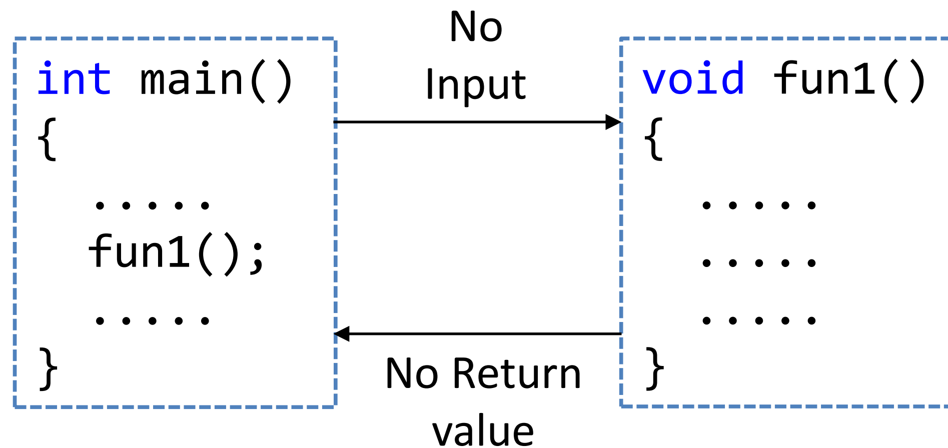


Categories of Functions Summary

(3) Function with no argument and returns value

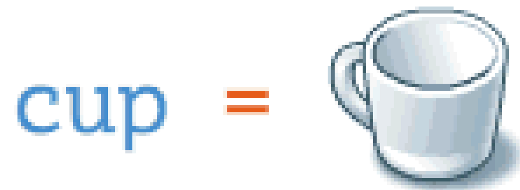


(4) Function with no argument and but no return value



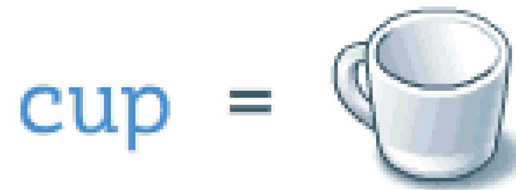
Call by Reference

pass by reference



fillCup(   )

pass by value



fillCup(   )

Call by reference

- The **call by reference** method of passing arguments to a function copies the reference of an argument into the formal parameter.
- Inside the function body, the reference is used to access the actual argument used in the call.

Actual Parameters

```
int main(){
        add(a,b);
}
```

Formal Parameters

```
void add(int x,int y){
        cout << x+y;
}
```

Note:

- *Actual parameters* are parameters as they appear in function calls.
- *Formal parameters* are parameters as they appear in function declarations / definition.

Program: Swap using pointer, reference

- Write a C++ program that to swap two values using function
    1. With pass by pointer
    2. With pass by reference

Program: Solution

```
void swapptr(int *x, int *y)
{
  int z = *x;
  *x=*y;
  *y=z;
}
void swapref(int &x, int &y)
{
  int z = x;
  x = y;
  y = z;
}
```

- Pointers as arguments
- References as arguments

```
int main()
{
  ...
  swapptr(&a,&b);
  swapref(a,b);
  ...
}
```

Program: Solution

```
void swapptr(int *, int *);
void swapref(int &, int &);
int main()
{
  int a = 45;
  int b = 35;
  cout<<"Before Swap\n";
  cout<<"a="<<a<<" b="<<b<<"\n";

  swapptr(&a,&b);
  cout<<"After Swap with pass by pointer\n";
  cout<<"a="<<a<<" b="<<b<<"\n";

  swapref(a,b);
  cout<<"After Swap with pass by reference\n";
  cout<<"a="<<a<<" b="<<b<<"\n";
}
```

Program: Solution (Cont…)

```
void swapptr(int *x, int *y)
{
  int z = *x;
  *x=*y;
  *y=z;
}
void swapref(int &x, int &y)
{
  int z = x;
  x = y;
  y = z;
}
```

OUTPUT

```
Before Swap
a=45 b=35
After Swap with pass by pointer
a=35 b=45
After Swap with pass by reference
a=45 b=35
```

Program: Return by Reference

- Write a C++ program to **return reference** of maximum of two numbers from function max.

Program: Solution

```
int& max(int &, int &);
int main()
{
   int a=5,b=6,ans;
   ans = max(a,b);
   cout<<"Maximum="<<ans;
}
int& max(int &x,int &y)
{
   if (x>y)
     return x;
   else
     return y;
}
```

- Function declaration returning reference

Program: Returning Reference

```
int x;
int& setdata();
int main()
{
    setdata() = 56;
    cout<<"Value="<<x;
    return 0;
}
int& setdata()
{
    return x;
}
```

- setx() is declared with a reference type,
  `int&`
  as the return type:
- `int& setx();`
  This function contains
  `return x;`
- You can put a call to this function on the left side of the equal sign:
  `setx() = 92;`
- The result is that the variable returned by the function is assigned the value on the right side of the equal sign.

C Preprocessors Macros

C Preprocessors Macros

- C **Preprocessor** is a text substitution in program.
- It instructs the compiler to do pre-processing before the actual compilation.
- All **preprocessor** commands begin with a hash symbol (#).

C Preprocessor Macro Example

```
#include <stdio.h>
#define PI 3.1415
#define circleArea(r) (PI*r*r)
int main()
{
    int radius;
    float area;
    printf("Enter the radius: ");
    scanf("%d", &radius);
    area = circleArea(radius);
    printf("Area = %f", area);
    return 0;
}
```

Preprocessor

- Every time the program encounters circleArea(argument), it is replaced by (3.1415*(argument)*(argument)).

Inline Functions

Inline Functions

- Every time a function is called it takes a lot of extra time to execute series of instructions such as
  1. Jumping to the function
  2. Saving registers
  3. Pushing arguments into stack
  4. Returning to the calling function
- If a function body is small then overhead time is more than actual code execution time so it becomes more time consuming.
- **Preprocessor macros** is a solution to the problem of small functions in C.
- In C++, **inline function** is used to reduce the function call overhead.

Inline Functions (Cont…)

Syntax:

```
inline return-type function-name(parameters)
{
    // function code
}
```

- Add **inline** word before the function definition to convert simple function to inline function.

Example:

```
inline int Max(int x, int y)
{
    if (x>y)
      return x;
    else
      return y;
}
```

Program: Inline function

- Write a C++ program to create inline function that returns cube of given number (i.e **`n=3`**, **`cube=(n*n*n)=27`**).

Program: Solution

```
#include <iostream>
using namespace std;

inline int cube(int s)
{
    return s*s*s;
}
int main()
{
    cout << "The cube of 3 is: " << cube(3);
    return 0;
}
```

- Calls inline function cube with argument 3

Critical situations Inline Functions

- Some of the situations inline expansion may not work
  1) If a **loop**, a **switch** or a **goto** exists in function body.
  2) If function is not returning any value.
  3) If function contains **static variables**.
  4) If function is **recursive**.

Function Overloading

Function Overloading

- Suppose we want to make functions that add 2 values, add 3 values , add 4 values

In C

```
int sum(int a, int b);
int sum(int a, int b, int c);
int sum(int a, int b, int c, int d);
```

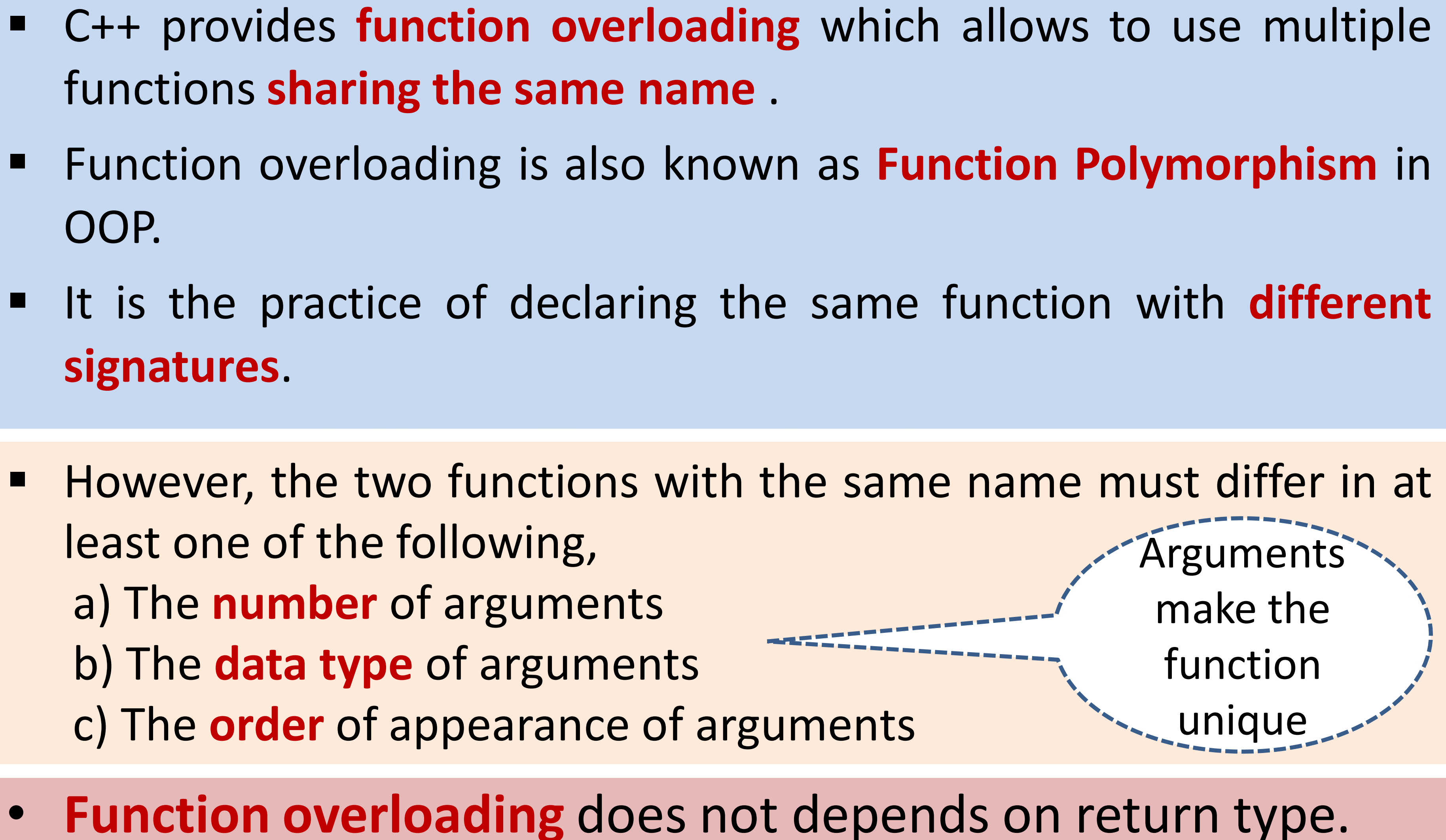
Function with same name in a program **is not allowed** in C language

In C++

```
int sum(int a, int b);
int sum(int a, int b, int c);
int sum(int a, int b, int c, int d);
```

Function with same name in a program **is allowed** in C++ language

Function overloading – Cont…



Function Overloading

Declaration	Result
`int sum(int a, int b);`	Valid
`float sum(int a, int b);`	Invalid
`int sum(int a, int c);`	Invalid
`int sum(int a, float b);`	Valid
`int sum(float b, int a);`	Valid
`float sum(float a, float b);`	Valid
`int sum(int a, int b, int c);`	Valid
`int sum(int a, float b, int c);`	Valid

Program: Function overloading

- Write a C++ program to demonstrate function overloading. Create function **display()** with different arguments but same name

Program: Solution (Cont…)

```
void display(int var)
{
    cout << "Integer number: " << var << endl;
}
void display(float var)
{
    cout << "Float number: " << var << endl;
}
void display(int var1, float var2) {
    cout << "Integer number: " << var1;
    cout << " and float number:" << var2;
}
```

Program: Solution

```
int main()
{
    int a = 5; float b = 5.5;
    display(a);
    display(b);
    display(a, b);
    return 0;
}
```

Program: Function overloading

- Write a C++ program to demonstrate function overloading. Create function **`area()`** that calculates area of circle, triangle and box.

Program #7 Solution

```
float area(int r)
{
  return 3.14*r*r;
}
float area(int h, int b)
{
  return 0.5*h*b;
}
float area(int l, int w, int h)
{
  return l*w*h;
}
int main(){
   cout<<"area of circle="<<area(5);
   cout<<“\n area of triangle="<<area(4,9);
   cout<<“\n area of box="<<area(5,8,2);
   return 0;
}
```

Default Function Arguments

Default Function Argument

Price : 1,000

Discount:

SAVE

5%

Price : 1,000

Discount: 20%

SAVE

20%

```
int cubevolume(int l=5, int w=6, int h=7)
{
    return l*w*h;
}
```

```
int main()
{
cubevolume();
cubevolume(9);
cubevolume(15,12);
cubevolume(3,4,7);
}
```

Here, there can be four types of function calls possible

If, argument is not specified then, compiler looks at declaration to see how many arguments a function uses and alert program to use default values

Default Argument Example

```
int volume(int l=5,int w=6, int h=7)
{
    return l*w*h;
}
int main() {
    cout<<"volume="<<volume()<<endl;
    cout<<"volume="<<volume(9)<<endl;
    cout<<"volume="<<volume(15,2)<<endl;
    cout<<"volume="<<volume(3,4,7)<<endl;
    return 0;
}
```

- Function call passing all arguments.
- Explicitly value **3,4,7** passed to **l,w,h** respectively.
- Default value **7** considered for **h** respectively.

Default Arguments

- while invoking a function If the argument/s are not passed then, the default values are used.
- We must add default arguments from right to left.
- We cannot provide a default value to a particular argument in the middle of an argument list.
- Default arguments are useful in situations where some arguments always have the same value.

```
int cubevolume( int l    , int w = 2, int h    )
{
   return l*w*h;
}
```

Default Arguments (Cont…)

- Legal and illegal default arguments

```
                                   Valid
void f(int a, int b, int c=0);
                                   Valid
void f(int a, int b=0, int c=0);
                                   Invalid
void f(int a=0, int b, int c=0);
                                   Invalid
void f(int a=0, int b, int c);
                                   Valid
void f(int a=0, int b=0, int c=0);
```

Common Mistakes

(1)

```
void add(int a, int b = 3, int c, int d = 4);
```

- You cannot miss a default argument in between two arguments.
- In this case, `c` should also be assigned a default value.

(2)

```
void add(int a, int b = 3, int c, int d);
```

- If you want a single default argument, make sure the argument is the last one.

Program: Default Arguments

- Write a C++ program to create function **`sum()`**, that performs addition of 3 integers also demonstrate Default Arguments concept.

Program: Default Arguments

```
#include <iostream>
using namespace std;
int sum(int x, int y=10, int z=20)
{
    return (x+y+z);
}
int main()
{
    cout << "Sum is : " << sum(5) << endl;
    cout << "Sum is : " << sum(5,15) << endl;
    cout << "Sum is : " << sum(5,15,25) << endl;
    return 0;
}
```

Thank You