Course Code: CL-1004	Course : Object Oriented Programming Lab
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CONTENTS:

1. PREDEFINED FUNCTIONS

Functions in C++ are similar to that of in Algebra. For Example, every function has a name and depending on the value specified by the user. It does some computation and gives an output (if any).

Some examples for the built in functions are given below.

Function	Header File	Purpose	Parameter(s) Type	Result
`abs(x)`	`<cmath>`	Returns the absolute value of its argument: `abs(-7) = 7`	`int (double)`	`int (double)`
`ceil(x)`	`<cmath>`	Returns the smallest whole number that is not less than x: `ceil(56.34) = 57.0`	`double`	`double`
`cos(x)`	`<cmath>`	Returns the cosine of angle x: `cos(0.0) = 1.0`	`double (radians)`	`double`
`exp(x)`	`<cmath>`	Returns e^x, where e = 2.718: `exp(1.0) = 2.71828`	`double`	`double`
`fabs(x)`	`<cmath>`	Returns the absolute value of its argument: `fabs(-5.67) = 5.67`	`double`	`double`

Example Code for Predefined Functions:

```
//How to use predefined functions.
#include <iostream>
#include <cmath>
#include <cctype>
using namespace std;
int main ()
{
      int x;
      double u, v;
      u = 4.2; //Line 1
      v = 3.0; //Line 2
      cout << "Line 3: " << u << " to the power of "
      << v << " = " << pow (u, v) << endl; //Line 3
      cout << "Line 4: 5.0 to the power of 4 = "
      << pow (5.0, 4) << endl; //Line 4
      u = u + pow (3.0, 3); //Line 5
      cout << "Line 6: u = " << u << endl; //Line 6
      x = -15; //Line 7
      cout << "Line 8: Absolute value of " << x
      << " = " << abs(x) << endl; //Line 8
      return 0;
}

Sample Run:
Line 3: 4.2 to the power of 3 = 74.088
Line 4: 5.0 to the power of 4 = 625
Line 6: u = 31.2
Line 8: Absolute value of -15 = 15
```

2. USER DEFINED FUNCTIONS

User defined functions are classified into two categories.

- **Value-Returning Functions:** These functions return a value of a specific type using *return* statement.
- **Void Functions:** These functions *do not* use a *return* statement to return a value.

VALUE-RETURNING FUNCTIONS:

Value-returning functions can be utilized in one of three ways:

- Save the value for further calculation.
- Use the value in some calculation.
- Print the value.

These function can be called in following scenarios.

- In an assignment statement.
- As a parameter in a function call.

- In an output statement.

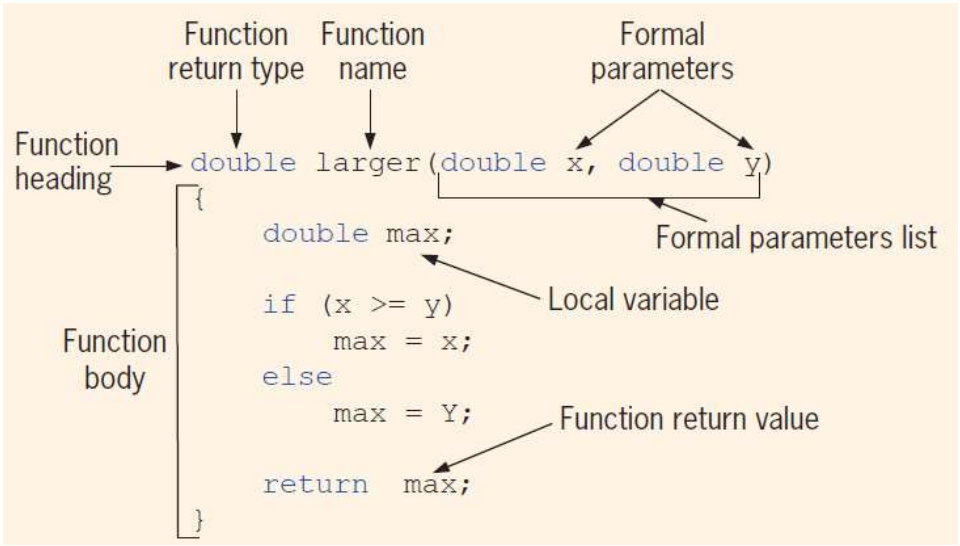
Syntax:

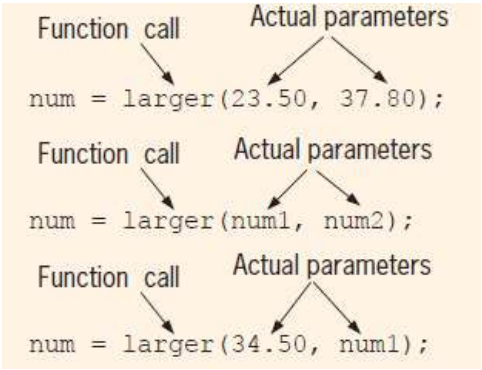
```
functionType functionName(formal parameter list)
{
    statements
}
```

Example Code for Value Returning Functions:

```
double larger (double x, double y)
{
    double max;
    if (x >= y)
    max = x;
    else
    max = y;
    return max;

}
```

Components:





Usage in cout:

```
cout << "The larger of 5 and 6 is " << larger (5, 6)
<< endl; //Line 1
cout << "The larger of " << one << " and " << two
<< " is " << larger (one, two) << endl; //Line 2
cout << "The larger of " << one << " and 29 is "
<< larger (one, 29) << endl; //Line 3
maxNum = larger (38.45, 56.78); //Line 4
```

Usage in another Function:

```
double compareThree (double x, double y, double z)
{
     return larger (x, larger (y, z));
}
```

Some Peculiarities in Functions:

A function with a returning must return a value. Consider the following function.

```
int secret (int x)
{
     if (x > 5) //Line 1
          return 2 * x; //Line 2
}
```

Now in this function when the condition of *x > 5* is not met then the return statement will not execute. Hence resulting in no return value. In this case function may or may not return a meaningful value. It may result some strange value.

3. FUNCTION PARAMETERS:

When passing parameters to a function there are ways to do that.

1. Value Parameters (Pass by Value).
2. Reference Parameters (Pass by Reference).

VALUE PARAMETERS:

When passing value parameters in a function, the parameter is copied into the corresponding formal parameter. There is no connection between the actual and formal parameter values, this means that these parameters cannot be used to pass the result back to the calling function.

Example Code for Value Parameters:

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

void funcValueParam (int num);

int main ()
{
     int number = 6; //Line 1
     cout << "Line 2: Before calling the function "
     << "funcValueParam, number = " << number
     << endl; //Line 2
     funcValueParam(number); //Line 3
     cout << "Line 4: After calling the function "
     << "funcValueParam, number = " << number
```

```
      << endl; //Line 4
      return 0;
}

void funcValueParam (int num)
{
      cout << "Line 5: In the function funcValueParam, "
      << "before changing, num = " << num
      << endl; //Line 5
      num = 15; //Line 6
      Value Parameters | 367
      cout << "Line 7: In the function funcValueParam, "
      << "after changing, num = " << num
      << endl; //Line 7
}

Sample Run:
Line 2: Before calling the function funcValueParam, number = 6
Line 5: In the function funcValueParam, before changing, num = 6
Line 7: In the function funcValueParam, after changing, num = 15
Line 4: After calling the function funcValueParam, number = 6
```

REFERENCE PARAMTERES:

When a reference parameter is passed in a function, it receives the address (memory location) of the actual parameter. Reference parameters can change the value of the actual parameter.

Reference parameters are useful in following situations.

1- When the value of the actual parameter needs to be changed.
2- When you want to return more than one value from a function.
3- When passing the address would save memory space and time relative to copying a large amount of data.

Example code for Reference Parameters:

```
//This program reads a course score and prints the
//associated course grade.
#include <iostream>
using namespace std;

void getScore (int& score);
void printGrade (int score);
int main ()
{
      int courseScore;
      cout << "Line 1: Based on the course score, \n"
      << " this program computes the "
      << "course grade." << endl; //Line 1
```

```
     getScore(courseScore); //Line 2
     printGrade(courseScore); //Line 3
     return 0;
}
void getScore (int& score)
{
     cout << "Line 4: Enter course score: "; //Line 4
     cin >> score; //Line 5
     cout << endl << "Line 6: Course score is "
     << score << endl; //Line 6
}
void printGrade (int cScore)
{
     cout << "Line 7: Your grade for the course is "; //Line 7
     if (cScore >= 90) //Line 8
          cout << "A." << endl;
     else if (cScore >= 80)
          cout << "B." << endl;
     else if (cScore >= 70)
          cout << "C." << endl;
     else if (cScore >= 60)
          cout << "D." << endl;
     else
          cout << "F." << endl;
}
```

```
Sample Run: In this sample run, the user input is shaded.
Line 1: Based on the course score, this program computes the
course grade.
Line 4: Enter course score: 85
Line 6: Course score is 85
Line 7: Your grade for the course is B.
```

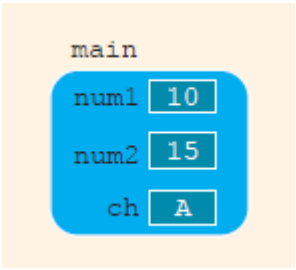
Example code for Value & Reference Parameters:

```
//Example 7-6: Reference and value parameters
#include <iostream>
using namespace std;

void funOne (int a, int& b, char v);
void funTwo (int& x, int y, char& w);

int main ()
{
     int num1, num2;
     char ch;
     num1 = 10; //Line 1
     num2 = 15; //Line 2
     ch = 'A'; //Line 3
     cout << "Line 4: Inside main: num1 = " << num1
     << ", num2 = " << num2 << ", and ch = "
```

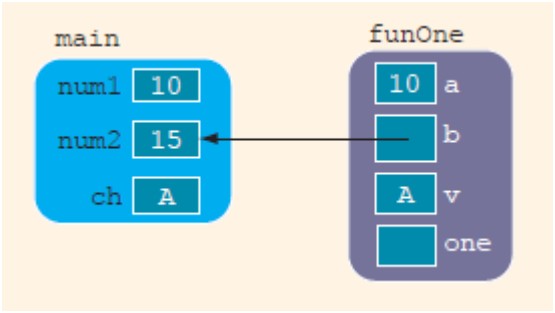
```
      << ch << endl; //Line 4
      funOne (num1, num2, ch); //Line 5
      cout << "Line 6: After funOne: num1 = " << num1
      << ", num2 = " << num2 << ", and ch = "
      << ch << endl; //Line 6
      funTwo (num2, 25, ch); //Line 7
      cout << "Line 8: After funTwo: num1 = " << num1
      << ", num2 = " << num2 << ", and ch = "
      << ch << endl; //Line 8
      return 0;
}

void funOne (int a, int& b, char v)
{
      int one;
      one = a; //Line 9
      a++; //Line 10
      b = b * 2; //Line 11
      v = 'B'; //Line 12
      cout << "Line 13: Inside funOne: a = " << a
      << ", b = " << b << ", v = " << v
      << ", and one = " << one << endl; //Line 13
}

void funTwo (int& x, int y, char& w)
{
      x++; //Line 14
      y = y * 2; //Line 15
      w = 'G'; //Line 16
      cout << "Line 17: Inside funTwo: x = " << x
      << ", y = " << y << ", and w = " << w
      << endl; //Line 17
}

Sample Run:
Line 4: Inside main: num1 = 10, num2 = 15, and ch = A
Line 13: Inside funOne: a = 11, b = 30, v = B, and one = 10
Line 6: After funOne: num1 = 10, num2 = 30, and ch = A
Line 17: Inside funTwo: x = 31, y = 50, and w = G
Line 8: After funTwo: num1 = 10, num2 = 31, and ch = G
```

REPRESENTATION OF VARIABLES:

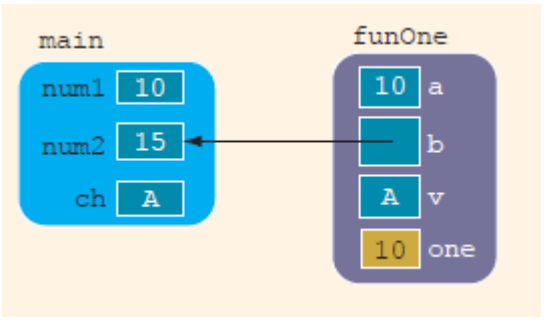
After Line 3:



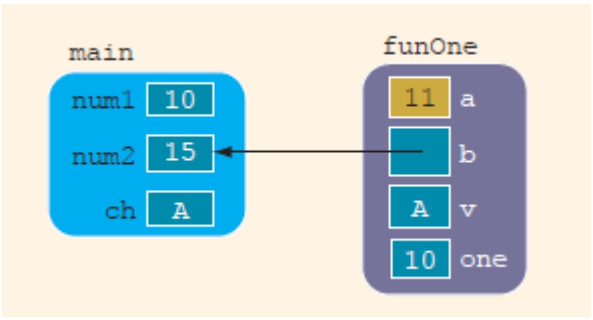
Before Line 9: (In Function *funOne*)



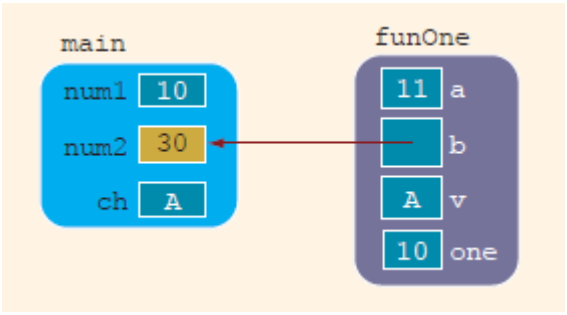
After Line 9:



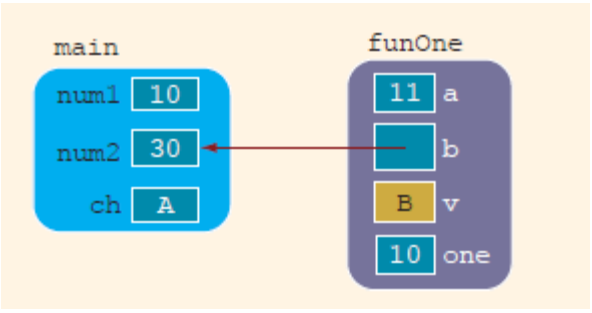
After Line 10:



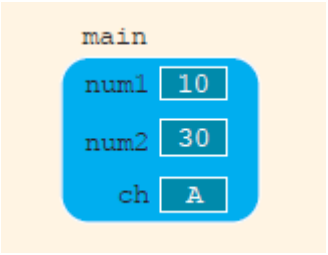
After Line 11:



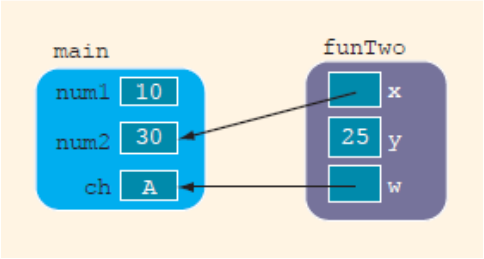
After Line 12:



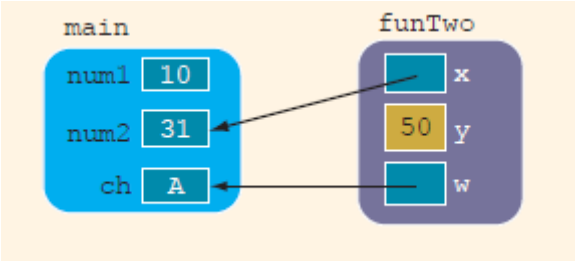
On Line 6: (When the function ends)



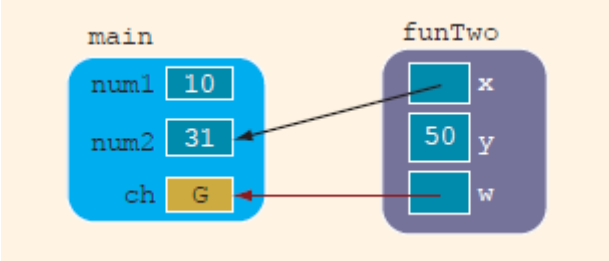
After Line 14: (In Function *funTwo*)



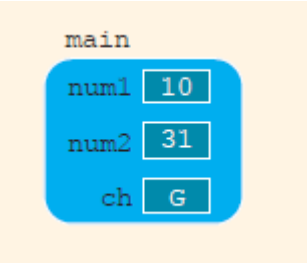
After Line 15:



After Line 16:



At Line 8 (When Function Ends):



4. SCOPE OF AN IDENTIFIER:

When talking about scope of an identifier we define it in two terms:

Local: Identifiers that are declared within a function or a block.
Global: Identifiers that are declared outside every function definition.

In general, the following rules apply when an identifier is accessed:

1. Global identifiers (such as variables) are accessible by a function or a block if:
    a. The identifier is declared before the function definition (block),
    b. The function name is different from the identifier,
    c. All parameters of the function have names different than the name of the identifier, and
    d. All local identifiers (such as local variables) have names different than the name of the identifier.

2. (Nested Block) An identifier declared within a block is accessible:
    a. Only within the block from the point at which it is declared until the end of the block, and
    b. By those blocks that are nested within that block if the nested block does not have an identifier with the same name as that of the outside block (the block that encloses the nested block).

3. The scope of a function name is similar to the scope of an identifier declared outside any block. That is, the scope of a function name is the same as the scope of a global variable.

Following program illustrates the rules of scope:

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

const double RATE = 10.50;
int z;
double t;
void one (int x, char y);
void two (int a, int b, char x);
void three (int one, double y, int z);

int main () {
     int num, first;
     double x, y, z;
     char name, last;
     ....
     return 0;
}
void one (int x, char y) {....}

int w;

void two (int a, int b, char x)
{
     int count;
     ....
}
void three (int one, double y, int z)
{
     char ch;
     int a;
     ....
     //Block four
     {
          int x;
          char a;
          ....
     }//end Block four
     ....
}
```

Identifier	Visibility in one	Visibility in two	Visibility in three	Visibility in Block four	Visibility in main
RATE (before main)	Y	Y	Y	Y	Y
z (before main)	Y	Y	N	N	N
t (before main)	Y	Y	Y	Y	Y
main	Y	Y	Y	Y	Y
local variables of main	N	N	N	N	Y
one (function name)	Y	Y	N	N	Y
x (one's formal parameter)	Y	N	N	N	N
y (one's formal parameter)	Y	N	N	N	N
w (before function two)	N	Y	Y	Y	N
two (function name)	Y	Y	Y	Y	Y
a (two's formal parameter)	N	Y	N	N	N
b (two's formal parameter)	N	Y	N	N	N
x (two's formal parameter)	N	Y	N	N	N
local variables of two	N	Y	N	N	N
three (function name)	Y	Y	Y	Y	Y
one (three's formal parameter)	N	N	Y	Y	N
y (three's formal parameter)	N	N	Y	Y	N
z (three's formal parameter)	N	N	Y	Y	N
ch (three's local variable)	N	N	Y	Y	N
a (three's local variable)	N	N	Y	N	N
x (Block four's local variable)	N	N	N	Y	N
a (Block four's local variable)	N	N	N	Y	N

5. STATIC & AUTOMATIC VARIABLES:

- A variable for which memory is allocated at block entry and deallocated at block exit is called an **automatic variable**.
- A variable for which memory remains allocated as long as the program executes is called a **static variable**.

Global variables are static variables by default and variables declared in a block are automatic variables. Syntax for declaring a static variable is:

```
static dataType identifier;
```

Example Code for Static Variables:

```
//Program: Static and automatic variables
#include <iostream>
using namespace std;
void test ();
int main ()
{
     int count;
     for (count = 1; count <= 5; count++)
          test ();
     return 0;
}
void test ()
{
     static int x = 0;
     int y = 10;
     x = x + 2;
     y = y + 1;
     cout << "Inside test x = " << x << " and y = "
     << y << endl;
}

Sample Run:
Inside test x = 2 and y = 11
Inside test x = 4 and y = 11
Inside test x = 6 and y = 11
Inside test x = 8 and y = 11
Inside test x = 10 and y = 11
```

Object Oriented Programing (CL-1004) Exercises

Task_01:

Write a C++ program where an array is given as input to a function along with it's size and an integer n. You job is to make the function work in a manner which will cyclically shift the indexes of the array to right, each element needs to be moved to the right as per the value indicated by n while the remaining n elements are moved to the beginning of the array.

For example: arr = [10 22 13 14 25 46]

n = 2

[25 46 10 22 13 14]

Task_02:

Write a C++ program that implements at least three functions, the functions can be "input", "cal" for calculation and "output". You need to read the length input by users in feet and inches and you need to calculate the equivalent length in meters and centimeters. The program must keep on repeating the same sequence (a loop can be used in this case) until the user wants to end the program.

1 foot – 0.3048 meters
1 meter – 100 centimeters
1 foot – 12 inches

Task_03:

Karachi has been reporting massive changes in temperature and the windspeed, a phenomenon known as the windchill factor take into account the temperature and the windspeed and can calculate the chilling effect that the wind can propagate at any certain temperature.

The formula for the windchill is given by:

W = 13.12 + 0.6215 * t – 11.37 * v0.16 + 0.3965 * t * v0.016

Where,

v = wind speed in m/sec
t = temperature in degrees Celsius: t <= 10
W = windchill index (in degrees Celsius)

You need to create a function that takes v and t as value parameters and return the value of W, the function must take the necessary precaution of ensuring that the restriction on the temperature in not breached.

Task_04:

Write a C++ program that includes a Boolean function which consists of a single parameter of type integer, as a Boolean function, the function is only permitted to return either "True" or "False". It must return true if the integer is a prime number existing between 1 and 1000 (Note to ponder: 1 is not always counted as a prime number). The function must keep repeating till the user wants it to.

Hints:
(i) if a number is not prime, it has at least one prime factor less than or equal to its square root,
(ii) (32 x 32) = 1024 and 1024 > 1000.

Task_05:

Write a C++ program that needs to calculate the total count of the occurrences of letters in a string. The occurrences must be in a form of a pair of letters, preferred method of solving this question is to use a character array.

Example: The lack of sleep is too much. I need to be sleeping more.
Enter the pair to be found: ee
This string contains 3 occurrences of the pair.

Task_06:

A method that some companies implement is to use letter to display their telephone numbers. For example, if a person requires emergency services, the number 555-8931 indicates HELP_NEED.

You need to create a function that allows the user to enter a telephone number in the form of letter and the function must print the prompted telephone number in digits. The first seven letters need to be considered only. The hyphen needs to be put after the 4th digit as well.