Ch 6. Functions
Part 1

CS 1428
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Lecture 20

Modular Programming

- Modular programming: breaking a program up into smaller, manageable functions or modules
- Function: a collection of statements to perform a task
- Motivation for modular programming:
  - Improves maintainability of programs
  - Simplifies the process of writing programs

This program has one long, complex function containing all of the statements necessary to solve a problem.

```
int main()
{
   statement;
   statement;
   statement;
   statement;
   statement;
   statement;
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   statement;
   statement;
   statement;
   statement;
   statement;
   statement;
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   statement;
   statement;
   statement;
   statement;
   statement;
   statement;
   statement;
   statement;
   statement;
}
```

In this program the problem has been divided into smaller problems, each of which is handled by a separate function.

```
int main()
{
   statement;
   statement;
   statement;
}
```

main function

```
void function2()
{
   statement;
   statement;
   statement;
}
```

function 2

```
void function3()
{
   statement;
   statement;
   statement;
}
```

function 3

```
void function4()
{
   statement;
   statement;
   statement;
}
```

function 4

Defining and Calling Functions

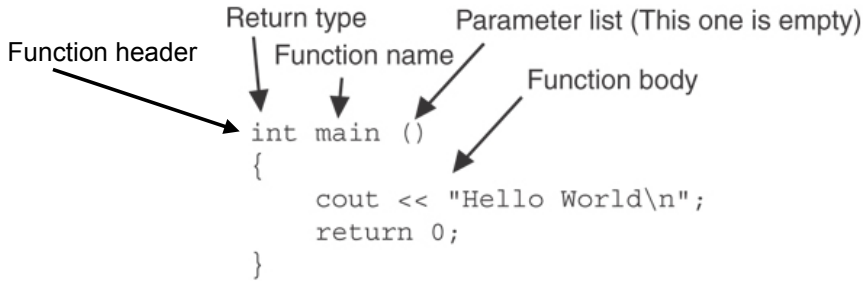
- Function call: statement that causes a function to execute
- Function definition: statements that make up a function

Function Definition

- Definition includes:
  - return type: data type of the value that the function returns to the part of the program that called it
  - name: name of the function. Function names follow same rules as variables
  - parameter list: variables containing values passed to the function
  - body: statements that perform the function's task, enclosed in { }

Function Definition

-
```
return-type  function-name (parameter declarations, if any)
{
   statements
}
```



Function Return Type

- If a function returns a value, the type of the value must be indicated:

```
int main()
```

- If a function does not return a value, its return type is <u>void</u>:

```
void printHeading()
{
   cout << "Monthly Sales\n";
}
```


Calling a Function

- To call a function, use the function name followed by ()

```
printHeading();
```

- When called, the program executes the body of the called function
- After the function terminates, execution resumes in the calling function after the function call.

Functions in a program

- Example:

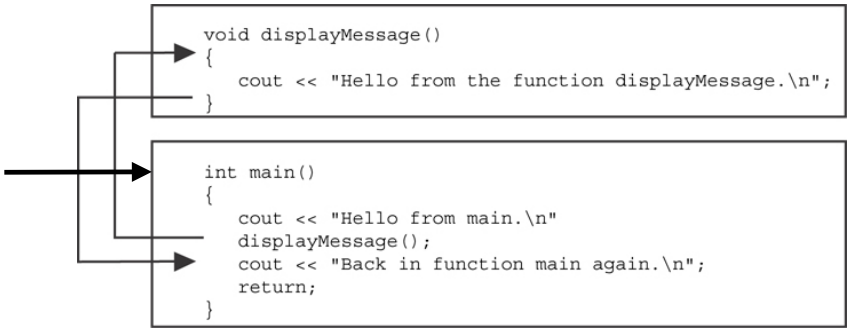
```
#include <iostream>
using namespace std;

void displayMessage()
{
   cout << “Hello from the function displayMessage.\n”;
}

int main()
{
   cout << “Hello from Main.\n”;
   displayMessage();
   cout << “Back in function Main again.\n”;
   return 0;
}
```


Functions in a program

- Output

```
Hello from Main.
Hello from the function displayMessage.
Back in function Main again.
```

- Flow of Control:



Calling Functions

- main can call any number of functions
- Functions can call other functions
- Compiler must know the following about a function before it is called:
  - name
  - return type
  - number of parameters
  - data type of each parameter

Function Prototypes

- Two ways to notify the compiler about a function before it encounters a call to the function:
  - Place the function definition before all calls to that function.
  - Place a function prototype (function declaration) before all calls to that function
    - Prototype looks like the function header
    - Example: `void printHeading();`

Prototypes in a program

- Example:

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

// function prototypes
void first();
void second();

int main()
{
   cout << "I am starting in function main.\n";
   first();
   second();
   cout << "Back in function main again.\n";
   return 0;
}
```


Prototypes in a program

- Example, cont.:

```
void first()
{
   cout << "I am now inside the function first.\n";
}

void second()
{
   cout << "I am now inside the function second.\n";
}
```

```
Output:
I am starting in function main.
I am now inside the function first.
I am now inside the function second.
Back in function main again.
```

Prototype Notes

- Place prototypes near the top of the program (before any other function definitions)
- Program must include either a prototype or full function definition before any call to the function – otherwise: compiler error
- With prototypes, you can place function definitions in any order in the source file

Sending Data into a Function

- You can pass values to a function through the function call:

```
c = pow(a, 2);
```

- Expressions (or values) passed to a function are called <u>arguments</u>
- Variables in a function that accept the values passed as arguments are <u>parameters</u>

A Function with a Parameter

```
void displayValue(int num)
{
   cout << "The value is " << num << endl;
}
```

- num is the parameter. It accepts int arguments.
- Calls to this function must have an argument of type int.

```
displayValue(5);
```


Function with parameter in program

- Example:

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

// Function Prototype
void displayValue(int);

int main() {
   cout << "I am passing 5 to displayValue.\n";
   displayValue(5);
   cout << "Back in function main again.\n";
   return 0;
}

void displayValue(int num) {
   cout << "The value is " << num << endl;
}
```

```
Output:
I am passing 5 to displayValue.
The value is 5
Back in function main again.
```

Parameter Passing behavior

- The function call, with the argument:

```
displayValue(5);
```

- Before the function executes, the parameter is <u>initialized</u> to the argument expression:

```
int num = 5;
```

- Then the body of the function is executed, using num as a variable:

```
cout << "The value is " << num << endl;
```


Parameters, Prototypes, and Function Headers

- the prototype must include the data type of each parameter inside its parentheses

```
void evenOrOdd(int);    //prototype
```

- the header must include a declaration for each parameter in its () (data type + param name)

```
void evenOrOdd(int num) //header
```

- the call must include an expression for each parameter, inside its parentheses.

```
evenOrOdd(val);         //call
```

Passing Multiple Arguments

- When calling a function and passing multiple arguments:
  - the number of arguments in the call must match the prototype and definition
  - the first argument will be used to initialize the first parameter, the second argument to initialize the second parameter, etc.

Function Call Notes

- The value of the argument expression is copied into the parameter (using initialization) when the function is called
- A function can have multiple parameters
- There must be a data type listed in the prototype and a parameter declaration in the function header for each parameter
- Arguments will be type converted as necessary to match parameters
- A parameter's scope is the function which uses it