Functions

Chapter 6, page 303

Functions

- "A collection of statements that perform a specific task", p 303
  - And can be accessed at any point in the code through a *function call* and optionally produce a value

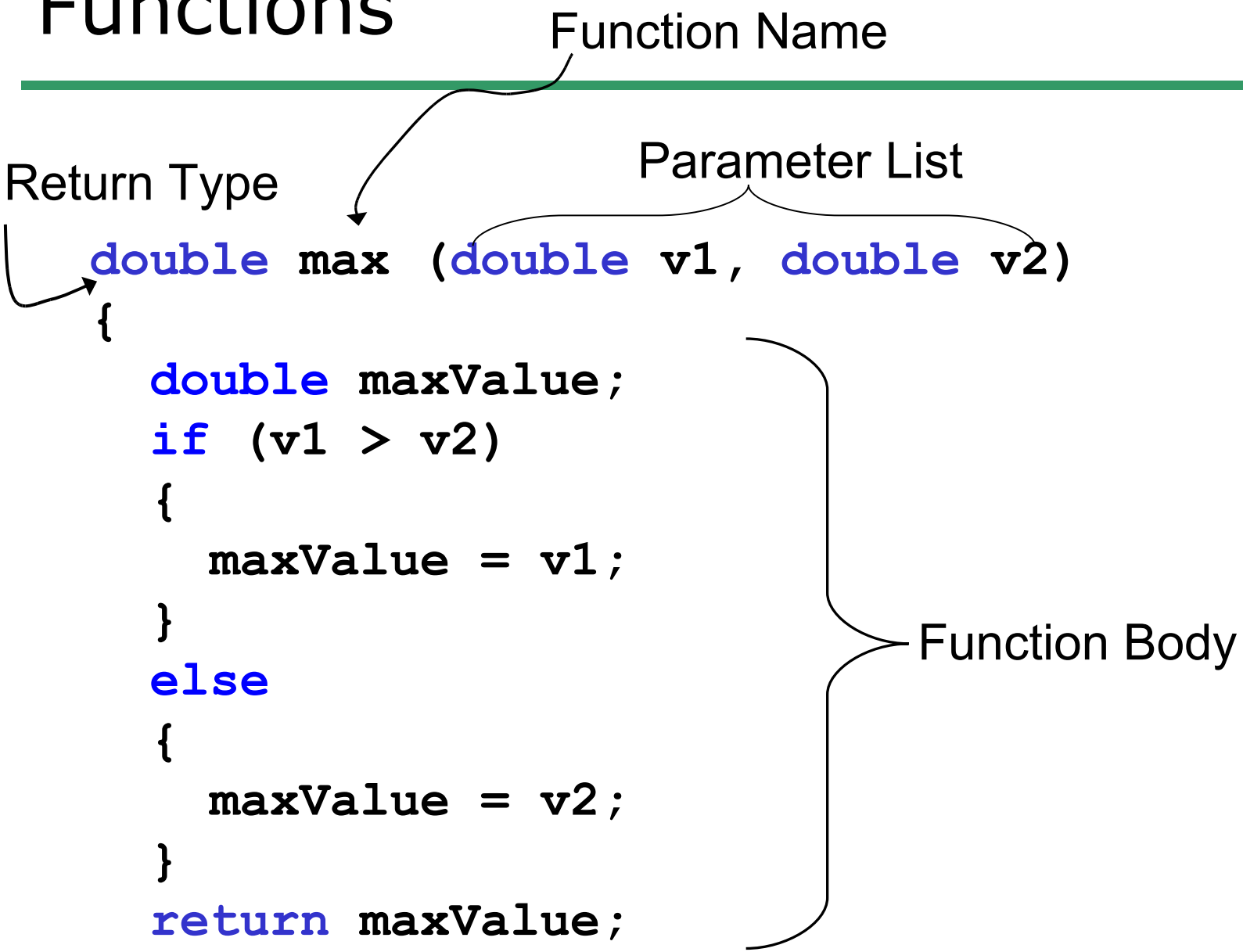
```
#include <cmath>

x = pow(2.0, 3);
x = pow(4.0, 0.32);
```

Functions

- Functions are a way of building *modules* in your program
- Encapsulate some calculation
- Less repetitive code
- Example:

```
x = pow(4.0, 2.2);
cout << x << endl;
```

Functions


Function Name
Return Type
Parameter List
double max (double v1, double v2)
{
double maxValue;
if (v1 > v2)
{
maxValue = v1;
}
else
{
maxValue = v2;
}
return maxValue;
}
Function Body

Calling a function

```
int main()
{
  double value1, value2;

  // must match data types & parameters
  value1 = max(4.2, 2.4);
  value2 = max(value1, 2.4);

  cout << value1 << " " << value2;

  return 0;
}
```

`void` Functions

- Not all functions need to produce a value

```
void printDayOfWeek (int day)
{
  if ( SUNDAY == day )
  {
    cout << " Sunday ";
  }
  else if (MONDAY == day )
  {
    cout << " Monday ";
  }
  . . .
  return; // no return value!
}
```

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

// place the function at the top of the file
void printSquares (int value, int value2)
{
   cout << value * value << " ";
   cout << value2 * value2 << endl;
  return;
}

int main()
{
  int x = 3, y = 2;
  printSquares(x, y);
  printSquares(y, x);
  return 0;
}
```

Practice

- Write a function that will calculate the average of three integers and print the result to the screen.
- What parameters do you need?
- What should the return type be?

- Write some C++ statements to call this function to determine the average of three integers given by the user.

Practice

- Write a function to calculate the factorial of a given integer.
- Remember: N! = n * (n-1) .... 2 * 1

- Write some C++ statements to use the function to print 4! to the screen

Commenting a function declaration

```
/*********************************************************

Function:    max

Description: finds the maximum value of two doubles

Parameters:  Value1 - a double, first of the pair

             Value2 - a double, second of the pair

Returned:    a double, the maximum of two values given

*********************************************************/

double max (double v1, double v2)
```

Compiling Functions

- The function declaration *must* be placed above the function's first use in the file

```
double max (double v1, double v2) // declaration
{
   . . .
   return maxValue;
}

int main()
{

   double value1 = 4.2;
   cout << max(value1, 2.4); // use
   return 0;
}
```

The compiler needs to check to ensure that the function is being called with the correct data types.

Compiling Functions, part 2

- Or, the a *function prototype* must be given before the function is used

```
double max (double v1, double v2);

int main()
{

  double value1 = 4.2;
  cout << max(value1, 2.4);
  return 0;
}

double max (double v1, double v2)
{
  . . .
  return maxValue;
}
```

Practice

- Write a function that flips the case of a letter. When an upper case letter is given, return the lower case version. When a lower case letter is given, return the upper case version.
- If a punctuation or numeric character is given, just return that character.
- What parameters do you need?
- What should the return type be?

Passing Arguments

- Arguments are passed into functions
- Parameters are evaluated in the order given
- A **copy** of the argument is made in the parameter
- If a parameter is changed in the function, is that reflected in main?

What will happen?

```
void swap (int value, int value2)
{
  int tmp = value;
  value = value2;
  value2 = tmp;
  cout << value << " " << value2 << endl;
  return;
}

int main()
{
  int x = 9, y = 10;
  swap(x, y);
  cout << x << " --- " << y << endl;
  return 0;
}
```

parameters

arguments

Passing Arguments

- Pass by value
  - arguments are **copied** into the parameter list
  - changes made in the function will **not** be reflected in main
- Pass by reference
  - changes made in the function are reflected in the main

Example

```
void swap(int &, int &);
int main(void)
{
  int i, j;
  cin >> i >> j;
  swap(i,j);
  cout << i << j;
  return 0;
}

void swap(int & num1, int & num2)
{
  int temp;
  temp = num1;
  num1 = num2;
  num2 = temp;
  return;
}
```

What is the output?

```
void changeIt(int, int&, int&);
int main()
{
  int i, j, k, l;
  i = 2;
  j = 3;
  k = 4;
  l = 5;
  changeIt(i, j, k);
  cout << i << j << k << endl;
  changeIt(k, l, i);
  cout << i << k << l << endl;
}
```

```
void changeIt(int j, int&
  i, int& l)
{
  i++;
  j += 2;
  l += i;
}
```

Rules for Parameter Lists

- Same number of arguments as parameters
- Arguments & parameters are matched by position
- Arguments & parameters must have the same type
- The names of the arguments and parameters may be the same or different
- For reference parameters only, the parameter must be a single, simple variable

Example

- Given the following function prototype:

```
void checkIt(float &, float &, int, int, char &);
```

- And declarations in main:

```
float x, y;

int m;

char next;
```

Which are legal?

```
checkIt(x, y, m+3, 10, next);
checkIt(m, x, 30, 10, 'c');
checkIt(x, y, m, 10);
checkIt(35.0, y, m, 12, next);
checkIt(x, y, m, m, c);
```

Program

- Write a function to compute the median and average of three integers, and return the two values.
- An example function call would look like:
  - **`medianAndAverage(4, 5, 6, median, average);`**

bool return values

```
bool isEven (int value)
{
  return (value % 2) == 0;
}

int main()
{
  int x = 9, y = 10;
  if( isEven(x) )
  {
    cout << "EVEN: " << x << endl;
  }
  if( isEven(y) )
  {
    cout << "EVEN: " << y << endl;
  }
  return 0;
}
```

Practice

- Write a function to calculate the area of a rectangle. This function should produce a value and return it to the calling function.
- Write another function to calculate the area of a circle.
  - what data type should each function return?
  - what parameters should each function accept?

Practice

- Build a small program that asks the user for either a rectangle or circle and displays the area of the selection shape. Use the functions we just defined.
- Continue asking for input until the user types something other than ‘r’ or ‘c’.