cisc1110 fall 2010 lecture VI.2

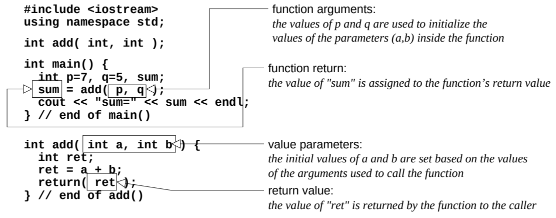
- *more on functions*
- more on “call by value” and “call by reference”
- passing strings to functions
- returning strings from functions
- variable **scope**
- global variables

“call by value” function parameters

- another **call by value** example:

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

int add( int, int ); // prototype

int main() {
  int p = 7, q = 5, sum;
  sum = add( p, q );
  cout << "sum=" << sum << endl;
} // end of main()

int add( int a, int b ) {
  int ret;
  ret = a + b;
  return( ret );
} // end of add()
```

- **call by value** parameters: example with annotations



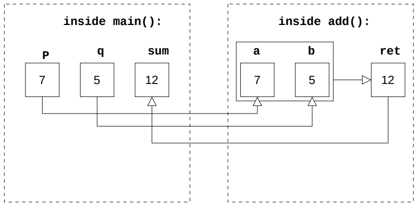
```
#include <iostream>
using namespace std;

int add( int, int );

int main() {
  int p=7, q=5, sum;
  sum = add( p, q );
  cout << "sum=" << sum << endl;
} // end of main()

int add( int a, int b ) {
  int ret;
  ret = a + b;
  return( ret );
} // end of add()
```

function arguments:
the values of p and q are used to initialize the values of the parameters (a,b) inside the function

function return:
the value of "sum" is assigned to the function’s return value

value parameters:
the initial values of a and b are set based on the values of the arguments used to call the function

return value:
the value of "ret" is returned by the function to the caller



- **call by value** parameters: same example as above, but using shorthand

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

int add( int, int ); // prototype

int main() {
  cout << "sum=" << add( 7, 5 ) << endl;
} // end of main()

int add( int a, int b ) {
  return( a + b );
} // end of add()
```

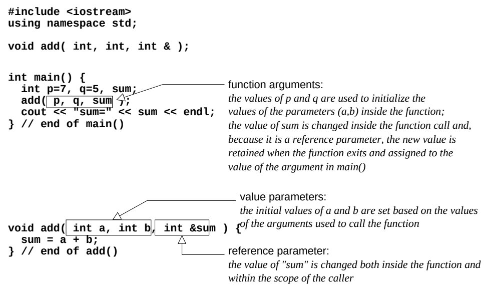
- the arguments in `main()` are constants (`7, 5`), which are used to initialize the variables (`a` and `b`) inside the function `add()`

“call by reference” function parameters

- another **call by reference** example:

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

int add( int, int, int & ); // prototype

void add( int a, int b, int &sum ) {
  sum = a + b;
} // end of add()

int main() {
  int p = 7, q = 5, sum;
  add( p, q, sum );
  cout << "sum=" << sum << endl;
} // end of main()
```

example with annotations:



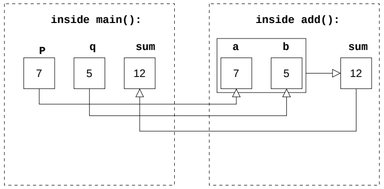
```
#include <iostream>
using namespace std;

void add( int, int, int & );

int main() {
  int p=7, q=5, sum;
  add( p, q, sum );
  cout << "sum=" << sum << endl;
} // end of main()
```

function arguments:
the values of p and q are used to initialize the values of the parameters (a,b) inside the function; the value of sum is changed inside the function call and, because it is a reference parameter, the new value is retained when the function exits and assigned to the value of the argument in main()

```
void add( int a, int b, int &sum ) {
  sum = a + b;
} // end of add()
```

value parameters:
the initial values of a and b are set based on the values of the arguments used to call the function

reference parameter:
the value of "sum" is changed both inside the function and within the scope of the caller



multiple function parameters

- you can write functions that have more than one parameter
- the parameters can be of any data type; they can even be different data types
- example:

```
int doMath( int A, int B, char op ) {
  int result;
  if ( op=='+' ) {
    result = A + B;
  }
  else if ( op=='-' ) {
    result = A - B;
  }
  else if ( op=='*' ) {
    result = A * B;
  }
  else {
    result = -999;
  }
  return result;
} // end of doMath()
```

classic example, "swap", which uses reference parameters

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

void swap( int &, int & ); // prototype

int main() {
  int p = 7, q = 5;
  cout << "before: p=" << p << " q=" << q << endl;
  swap( p, q );
  cout << " after: p=" << p << " q=" << q << endl;
} // end of main()

void swap( int &a, int &b ) {
  int tmp;
  tmp = a;
  a = b;
  b = tmp;
  return;
} // end of swap()
```

compare with “noswap”, which uses value parameters

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

void noswap( int, int ); // prototype

int main() {
  int p = 7, q = 5;
  cout << "before: p=" << p << " q=" << q << endl;
  noswap( p, q );
  cout << " after: p=" << p << " q=" << q << endl;
} // end of main()

void noswap( int a, int b ) {
  int tmp;
  tmp = a;
  a = b;
  b = tmp;
  return;
} // end of noswap()
```

passing C++ strings to functions

- you pass C++ strings to functions in the same way that you pass primitive variables
- example “call by value string parameters:

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

void noswap( string, string ); // prototype

int main() {
  string p = "hello", q = "goodbye";
  cout << "before: p=" << p << " q=" << q << endl;
  noswap( p, q );
  cout << " after: p=" << p << " q=" << q << endl;
} // end of main()

void noswap( string a, string b ) {
  string tmp;
  tmp = a;
  a = b;
  b = tmp;
  return;
} // end of noswap()
```

- example “call by reference” string parameters:

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

void swap( string &, string & ); // prototype

int main() {
  string p = "hello", q = "goodbye";
  cout << "before: p=" << p << " q=" << q << endl;
  swap( p, q );
  cout << " after: p=" << p << " q=" << q << endl;
} // end of main()

void swap( string &a, string &b ) {
  string tmp;
  tmp = a;
  a = b;
  b = tmp;
  return;
} // end of swap()
```

returning strings from functions

- you return C++ strings from functions in the same way that you return primitive variables
- example:

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

string getMove( char ); // function prototype

int main() {
  cout << "C = " << getMove( ’C’ ) << endl;
  cout << "D = " << getMove( ’D’ ) << endl;
} // end of main()


string getMove( char move ) {
  switch( move ) {
  case ’C’:
    return "cooperate";
    break;
  case ’D’:
    return "defect";
    break;
  }
  return " ";
} // end of getMove()
```

passing C strings to functions

- passing C strings is more complicated
- this is because C strings are always reference parameters (has to do with how they are stored)
- so just be careful if you pass C strings as parameters and know that if their value will changes inside the function, the new value will be retained outside
- here’s an example:

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

int countVowels( char [] );
void transform( char [] );

int main() {
  char mystring[] = "hello";
  cout << "mystring = [" << mystring << "] ";
  cout << "number of vowels = " << countVowels( mystring ) << endl;
```

```
  cout << "before transform: [" << mystring << "]\n";
  transform( mystring );
  cout << "after transform: [" << mystring << "]\n";
} // end of main()

int countVowels( char a[] ) {
  int sum = 0;
  for ( int i=0; i<strlen(a); i++ ) {
    if (( a[i] == ’A’ ) || ( a[i] == ’a’ ) ||
        ( a[i] == ’E’ ) || ( a[i] == ’e’ ) ||
        ( a[i] == ’I’ ) || ( a[i] == ’i’ ) ||
        ( a[i] == ’O’ ) || ( a[i] == ’o’ ) ||
        ( a[i] == ’U’ ) || ( a[i] == ’u’ )) {
      sum++;
    }
  }
  return( sum );
} // end of countVowels()

void transform( char a[] ) {
  for ( int i=0; i<strlen(a); i++ ) {
    a[i] = toupper( a[i] );
  }
} // end of transform()
```

- Note that you can return C strings from functions, but it is more complicated and involves a syntax and concepts that are beyond the scope of this class
- You will likely cover that in the next course (CISC 3110)
- So, if you want a function to return a string, then use C++ strings

variable scope

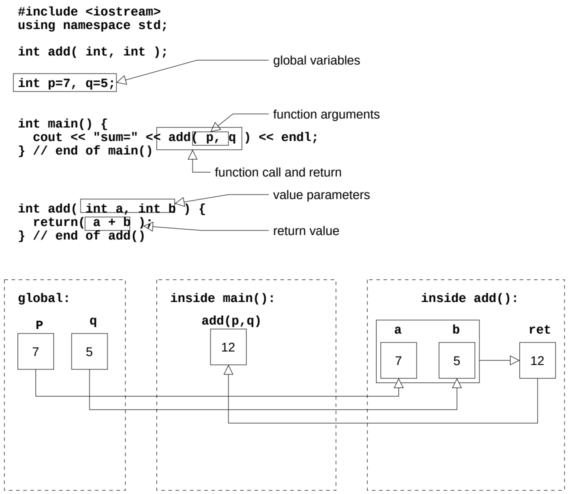
- variables are defined within either a *global* or a *local* scope
- *local* variables are defined inside a function and these “go away” when the function exits
- *global* variables are defined outside of any function, and these do not go away (as long as the program is running)
- in the example below:
  - a and b are local variables declared inside `add()`;
    their *scope* is the function `add()`;
    when `add()` exits, a and b no longer exist
  - p and q are local variables declared inside `main()`;
    their *scope* is the function `main()`;
    they also go away when `main()` exits, which is the same thing as when the program exits, because `main()` is the special function that controls the program

global variables example

- example similar to those above, except using global variables

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

int add( int, int ); // prototype

int p = 7, q = 5; // declare global variables

int main() {
  cout << "sum=" << add( p, q ) << endl;
} // end of main()

int add( int a, int b ) {
  int ret;
  ret = a + b;
  return( ret );
} // end of add()
```

- example with annotations:



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

int add( int, int );

int p=7, q=5;

int main() {
  cout << "sum=" << add( p, q ) << endl;
} // end of main()

int add( int a, int b ) {
  return( a + b );
} // end of add()
```