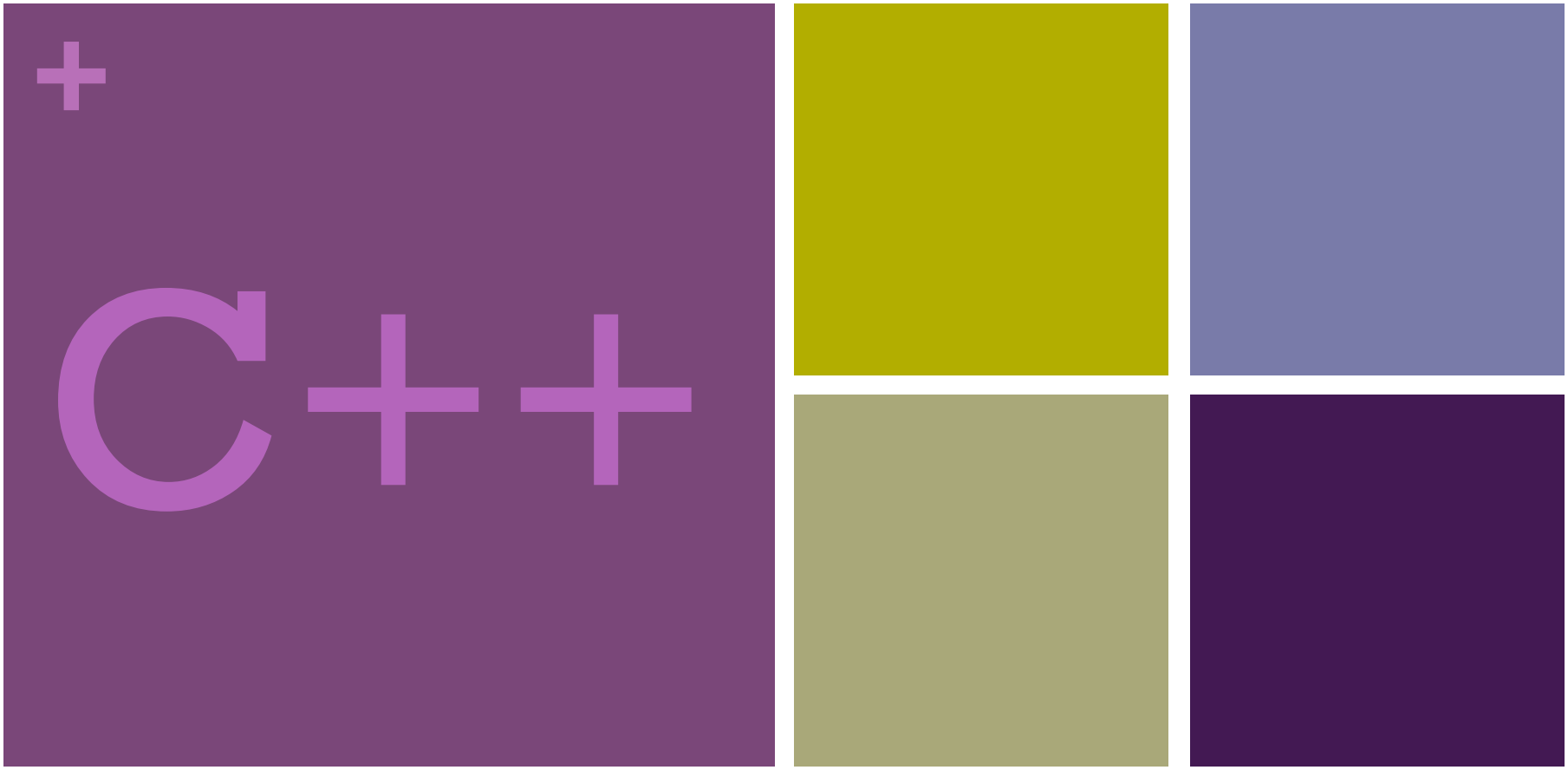
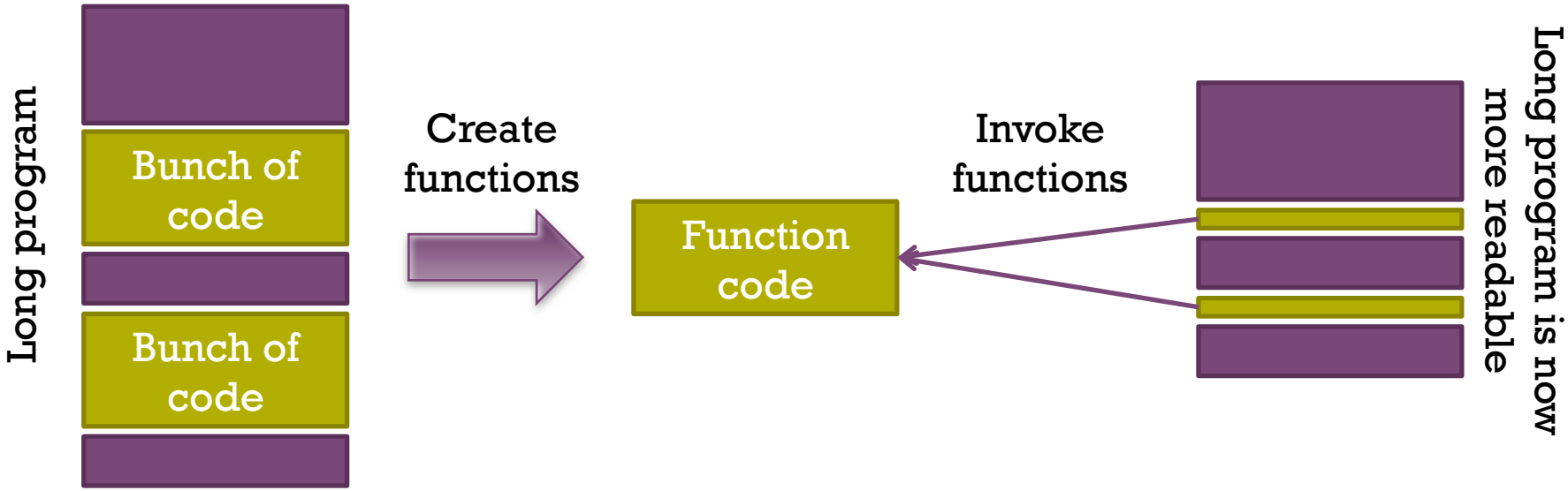


Functions + Debugger

Section 1D

Why do we need to write functions?

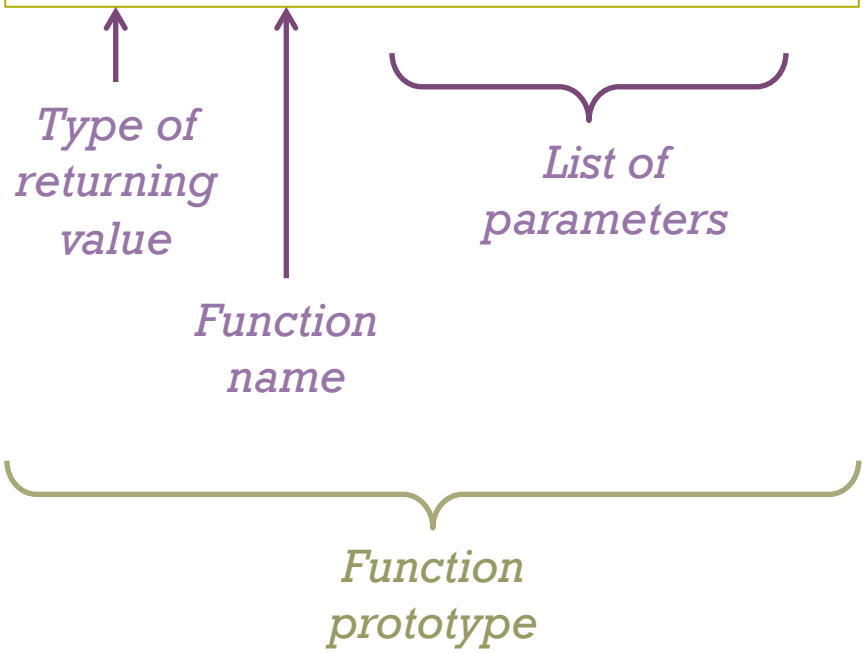
- Readability
  - Our program is not cluttered with complex code.
- Reusability
  - We can use the same "module" here and there, whenever we have to perform the same thing.



How do we create a function?

✧Declaration:

```
double power( double, int );
```



✧Definition:

```
// Function header.
double power( double x, int y )
{
   // Function body.
   double p = 1.0;
   for( int i = 0; i < y; i++ )
      p *= x;

   return p;
}
```

Anything else about declaring a function?

- Declare a function *__before__* it is used.
- If your function does not return anything, use `void`.
  - `void greet( string name );`
- If your function has more than one input parameter, use commas to separate them.
  - `double bodyMassIndex( double height, double weight, string name );`
- You can disregard parameter names *ONLY* in the function declaration.
  - `double bodyMassIndex( double, double, string );`

Anything else about defining a function?

- You may define and declare your function at the same time!
- A function has its own block or space of variables, known as "**scope**"
  - Variables within a function are called "**local**."
  - Variables outside *all* functions are called "**global**" and can be accessed from everywhere.
- The input parameters (if any) are variables declared in the scope of the function (see later for calling functions by value and by reference).
- Use a `return` statement to finish (prematurely) and/or return a value.
  - `return x * x;`
  - `return;    // If function was defined as void function()`

Example

```
double power( double, int );
```

Declaration

```
int main( )
{
   double base;
   cin >> base;
   int exponent;
   cin >> exponent;

   cout << power( base, exponent ) << endl;
}
```

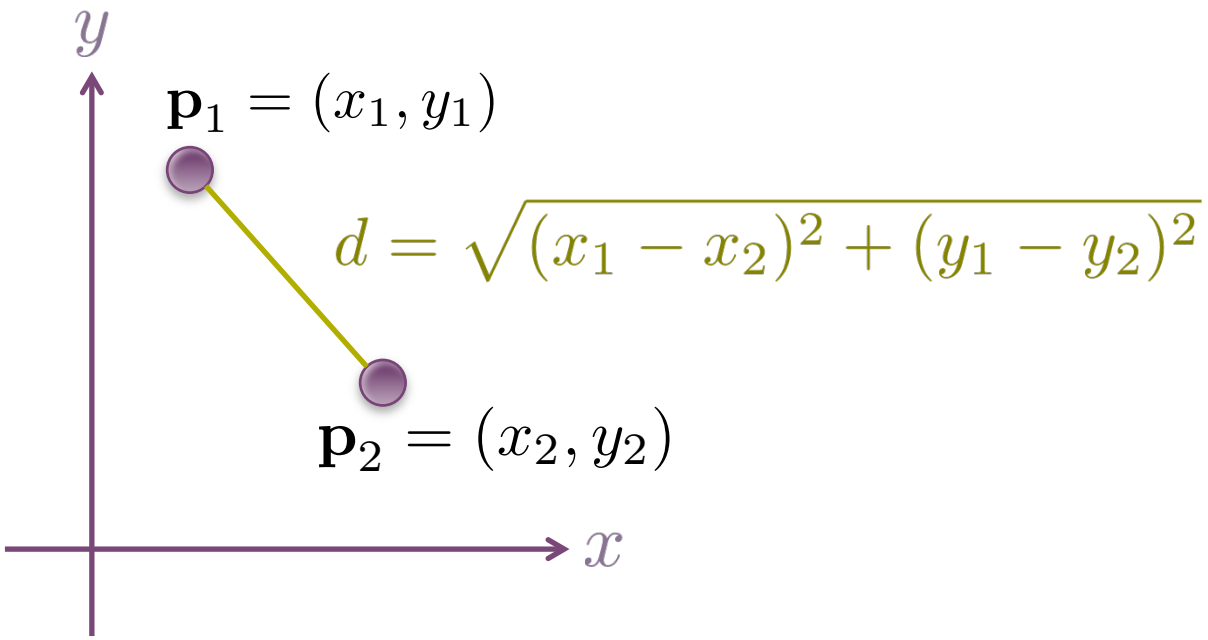
Usage

```
double power( double x, int y )
{
   double p = 1.0;
   for( int i = 0; i < y; i++ )
      p *= x;
   return p;
}
```

Definition

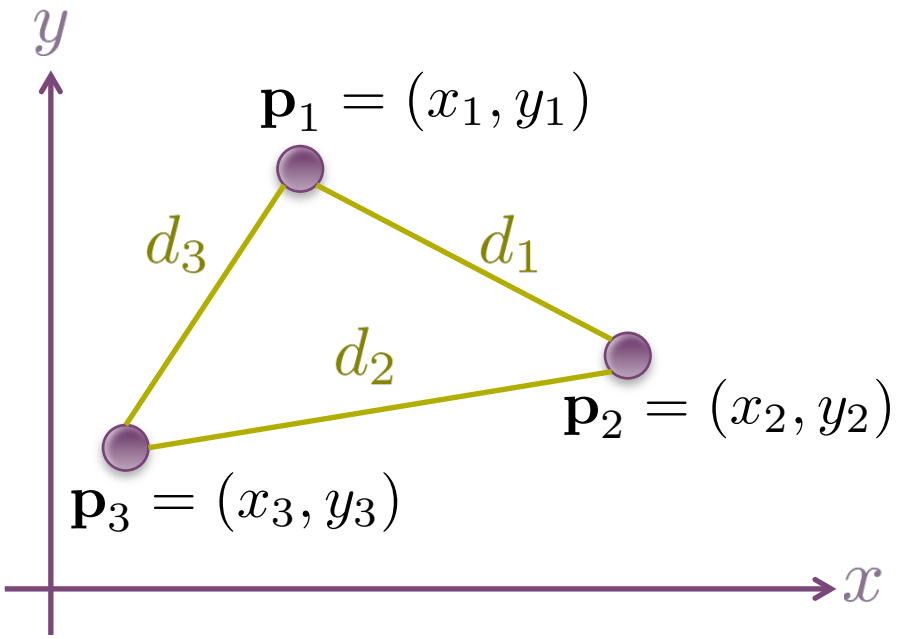
Exercise

- Write a function that computes the distance between two 2D points.



Exercise

- Write a program that computes the perimeter of a triangle. The user must provide the 2D coordinates of the three points. Use the function you wrote in the previous exercise.



Exercise

- Is there an error in the following function. If so, how can we fix it? If not, what does the function do?

```
int g( void )
{
    cout << “Inside function g” << endl;

    int h( void )
    {
        cout << “Inside function h” << endl;
    }
}
```

Exercise

- Is there an error in the following function. If so, how can we fix it? If not, what does the function do?

```
int sum( int x, int y )
{
   int result;

   result = x + y;
}
```

Exercise

- Is there an error in the following function. If so, how can we fix it? If not, what does the function do?

```
void f( string a )
{
    string a;

    cout << a;
}
```

Exercise

- Is there an error in the following function. If so, how can we fix it? If not, what does the function do?

```
void product( void )
{
    int a, b, c, result;

    cout << "Introduce three integers:" << endl;
    cin >> a >> b >> c;
    result = a * b * c;

    cout << "The result is: " << result << endl;

    return result;
}
```

Exercise

- Write a function that displays a solid square of characters `fillChar`, whose side length is specified by `side`. For instance, if `side = 4`, and `fillChar = '#'`, then, the function outputs:

```
####
####
####
####
```

Exercise

- The **Fibonacci** series

0, 1, 1, 2, 3, 5, 8, 13, 21, …

starts with 0 and 1, and has the property that each term is the sum of the its previous two terms. Write a function `int fibonacci( int n )`, that computes the n^{th} Fibonacci term in the series. For example:

fibonacci(0) = 0
fibonacci(2) = 1
fibonacci(5) = 5
fibonacci(8) = 21

Parameters by value and by reference

- By value

Caller

```
double squareRoot( double x )
{
   return sqrt( x );
}
```

```
...
double v;
cin >> v;

cout << squareRoot( v );
...
```

Parameters by value and by reference

✧By reference

Caller

```
bool squareRoot( double x, double& s )
{
   if( x < 0 )
      return false;

   s = sqrt( x );
   return true;
}
```

```
double r;
double v;
cin >> v;

if(squareRoot( v, r ))
   cout<< r;
else
   cout<< "Imaginary";
```

Exercise

- A **palindrome** is a word, phrase, number, or a sequence of characters which reads the same backward and forward, like:

  "Race Car", "taco cat", "Was it a car or a cat I saw?"

Write a function `bool isPalindrome(string s, string& r)`, that checks whether string `s` is a palindrome. If so, it should return `true` and leave `r` unchanged. If not, it should return `false` and copy into `r` string `s` but backwards. Assume that `s` contains only letters (no spaces, digits, or other punctuation characters).

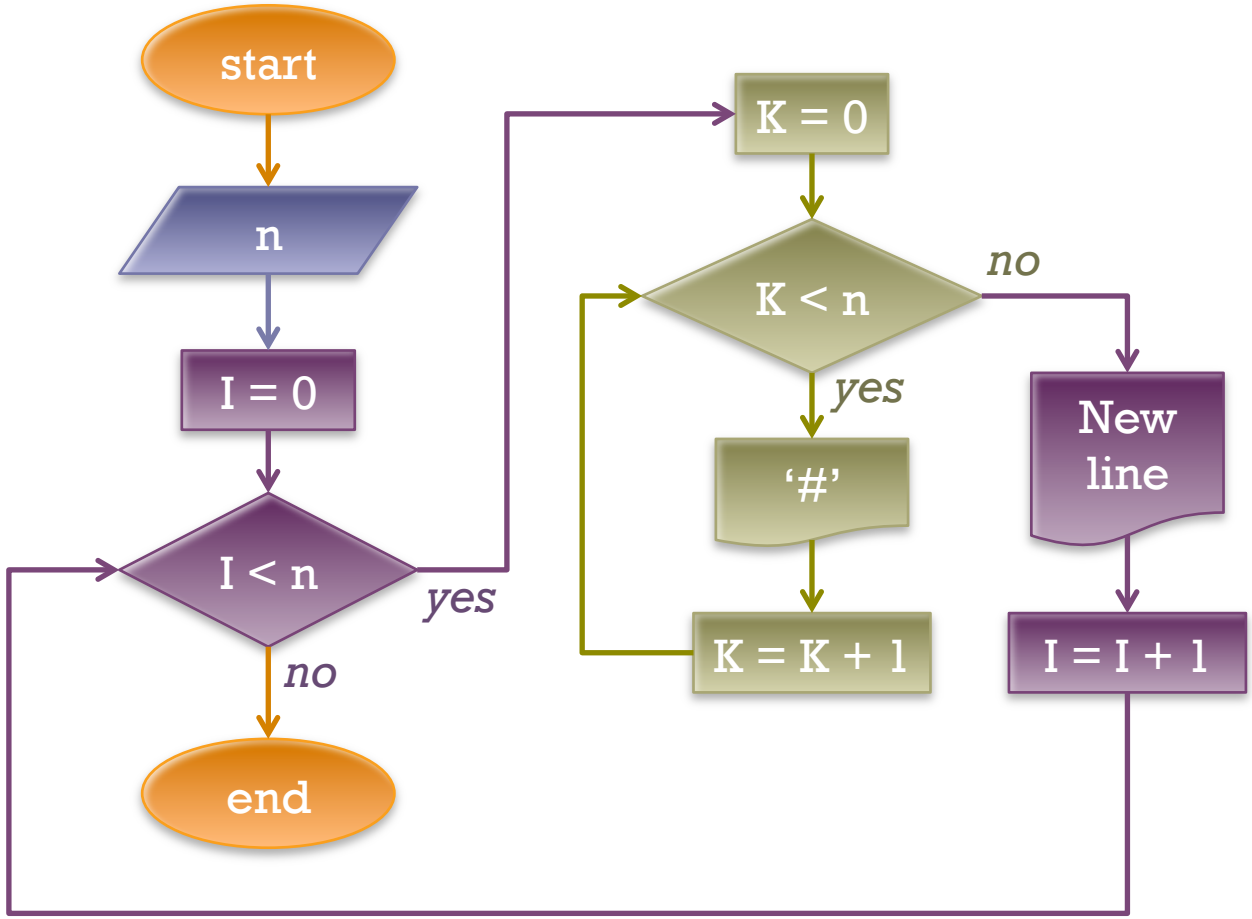
Exercise

- Design a function `bool strToNumber( string s, int& n )` that converts a "numeric" string `s` into an integer `n` if `s` is valid (i.e. contains only digits) and returns `true`. If `s` is invalid, the function returns `false`, and `n` is left unmodified.

- `s = "012345"`, function returns `true`, and `n = 12345`
- `s = "0.12k"`, function returns `false`, and `n` is undefined

A word on pseudocode

- Translate your (detailed) C++ code to simple words (or the other way around?) - Recall **flow charts**!



Pseudocode

Read a number *n* from the user.
Iterate *n* times:
    Print *n* '#' characters starting from the left of a new line.

The Debugger (Xcode)

```
37  bool isPalindrome( string s, string& r )
38  {
39      string lowerS = "";
40      string backwardS = "";
41      string lowerBackwardS = "";
42
43      for( size_t I = 0; I < s.size(); I++ )                    Thread 1: breakpoint 1.1
44      {
45          char c = tolower( s[I] );
46          lowerS += c;
47          backwardS = s[I] + backwardS;       // This backward version contains characters in upper/lower case.
48          lowerBackwardS = c + lowerBackwardS;// This backward version contains characters only in lower case.
49      }
50
51      if( lowerS == lowerBackwardS )
52          return true;
53
54      r = backwardS;
55      return false;
56
57  }
```

0 isPalindrome(std::__1::basic_string<char, std::__1::ch...std::__1::char_traits<char>, std::__1::allocator<char> >&)

- **r** = (string &) ""
- **s** = (std::__1::string) "HelloWorld"
- **lowerBackwardS** = (std::__1::string) ""
- **I** = (size_t) 1
- **backwardS** = (std::__1::string) ""
- **lowerS** = (std::__1::string) ""

(lldb)

Auto

All Output

The Debugger (Visual Studio)