Arrays (and strings)
Ch 7

Why science teachers are not asked to monitor recess.
Quiz time
Highlights

- arrays
  ```
  int x[4];
  x[0] = 1;
  ```

- string functions
  ```
  string x = "hello there!";
  cout << x.substr(x.find('t'));
  ```
string

We have been using strings to store words or sentences for a while now.

However, when we type “string x” it does not turn blue, as it is not a fundamental type (like char).

Strings are basically a grouping of multiple chars together in a single variable.
String greeting = “Hello”;

The position of a character is called its **index**.

Note that the index starts from zero, not one (this is just to make your life miserable)
string functions

String greeting = “Hello”;

```
Hello
0 1 2 3 4
```

greeting.length();

returns value 5 (int)

Tells how many characters are in the variable
string concatenation

Hello + World

= HelloWorld

String concatenation does not automatically add a space
(see: stringConcatenation.cpp)
There are also some other useful functions (see book or google for a full list)

Some of the more useful ones are:
- `.at(int index)`: character at the index
- `.find()`: finds first character or string
- `.substr(int start)`: pulls out part of the original string

(see: string.cpp)
Arrays

Arrays are convenient ways to store similar data types (like multiple chars for a string)

Arrays are indexed starting from 0, so index 0 is the first element, index 1 is the second element ...

Unlike strings, you can make an array of whatever type you want (any type!)
When making an array, you need both a type and a length.

The format for making an array is below:

```java
int x[5]; // 5 ints
```

- **Type in array**
- **variable name**
- **[] for array, length of array between**
Arrays - elements

To access an element of an array, use the variable name followed by the index in [ ]

\[x[1] = 2;\]

(See: simpleArray.cpp)
Arrays

Note that the number in the [ ] is inconsistent:

1. First time (declaration): this is the length

2. All other times: this is the index of a single value inside the array

If you want to indicate a whole array, just use the variable name without any [ ] (more on this later)
Arrays - manual initialization

Arrays can be initialized by the following: (must be done on declaration line!)

```
int x[] = {1, 4, 5, 2};
```

If you access outside of your array you will either crash or get a random value

You can also use a constant variable to set the size:

```
const int size = 8;
int x[size];
```

(See: average.cpp)
Arrays

When you make an array, the computer reserves space in memory for the size

The array variable is then just a reference to the first element's memory location

The computer simply converts the index into an offset from this initial location (see arrayAddress.cpp)
Memory

Memory:

CAUTION OFF LIMITS  CAUTION OFF LIMITS

Code:
Memory (declaration)

Memory:

#0 (int) x

Code:

int x;
Memory (declaration)

Memory:

```
#0 (int) x  #1 (int) y[0]  #2 (int) y[1]  #3 (int) y[2]
```

Code:

```
int x;
int y[3];
```
C-Strings and strings

There are actually two types of “strings” (multiple characters) in C++

A C-String is a char array, and this is what you get when you put quotes around words

```
cout << "HI!\n";  // C-String
```

A string (the thing you #include) is a more complicated type called a class (few weeks)
C-Strings and strings

It is fairly easy to convert between C-Strings and strings:

```cpp
char cString[] = "move zig";
string IMAString = cString;
cout << IMAString.c_str() << endl;
// above converts it back to C-String
```

You can also convert between numbers and strings:

```cpp
char number1[20];
string number2;
cin >> number1 >> number2;
cout << "sum is: " << (atof(number1) + stod(number2)) << endl;
```

(see: stringConversion.cpp)
C-Strings and strings

C-Strings are basically strings without the added functions.

```c
char word[] = {'o', 'm', 'g', '\0'};
```

You should end C-Strings with null character, as this tells cout when to stop displaying.

This means you can initialize char arrays with quotes (BUT NOT OTHER ARRAYS) (see: cstring.cpp)