C / C++ Basics

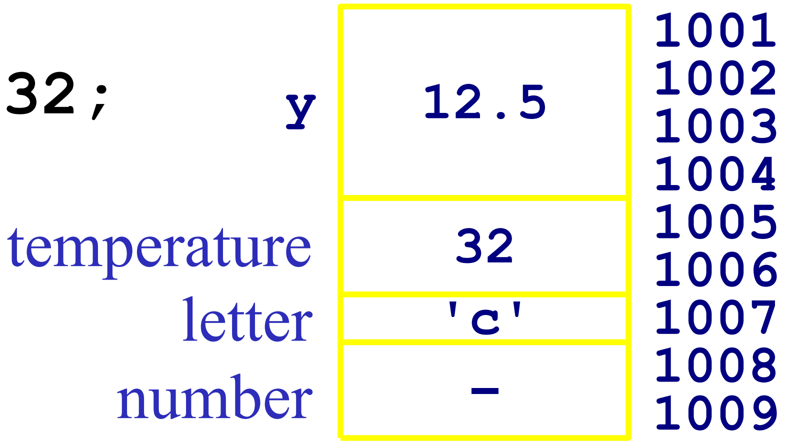
Materials adapted from Dianna Xu, Walter Savitch, Jim Cohoon and Jack Davidson

Today’s Goals

- Short-hands, prefix and postfix
- **`for`** loops
- Arrays
- Arrays and **`char`**s
- **`ctype.h`**
- **`stdlib.h`**
- **`C++ strings`**
- **`C++ I/O streams`**

Memory Depiction

```
float y = 12.5;
short temperature = 32;
char letter = 'c';
short number;
```



Shorthand

```
int i = 1, end = 100, val = 0;

  while (i <= end) {
    val += i;
    i += 1;
  }
```

```
val += i; ⇔ val = val + i;
```

Also for other operators

Further Shorthand

```
int i = 1, end = 100, val = 0;

while (i <= end) {
   val += i;
   i++;
}
```

`i++; ⇔ i = i + 1;`

Shorthands: `op=`, ++i, i++

- `+=`, `-=`, `*=`, `/=`, `%=`
- Prefix form increments `i`'s value before it is referenced
  - `i = 5;`
  - `x = (++i) + 6;`

```
i = 6
x = 6 + 6 = 12
```

- Postfix form increments `i`'s value after it is referenced
  - `i = 5;`
  - `x = (i++) + 6;`

```
i = 6
x = 5 + 6 = 11
```

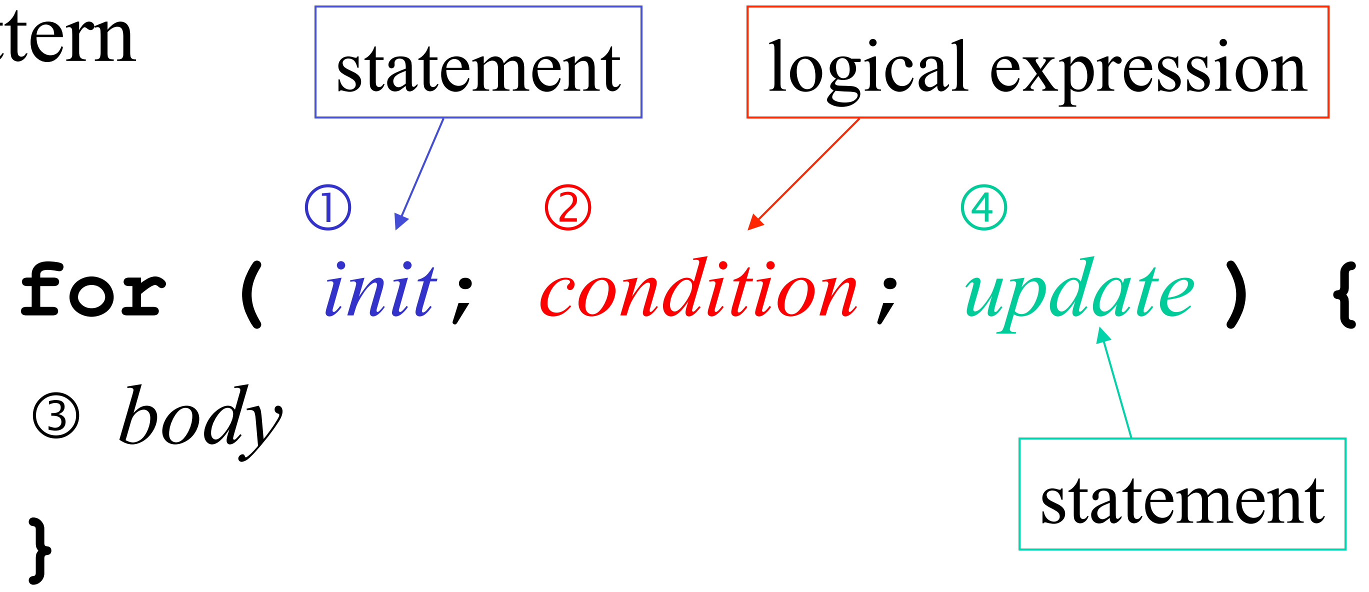
for Loops

```
int i = 1, end = 100, val = 0;

while (i <= end) {
  val += i;
  i++;
}
```

```
int i, end = 100, val = 0;

for (i = 1; i <= end; i++) {
  val += i;
}
```

`for` Loop

- Pattern



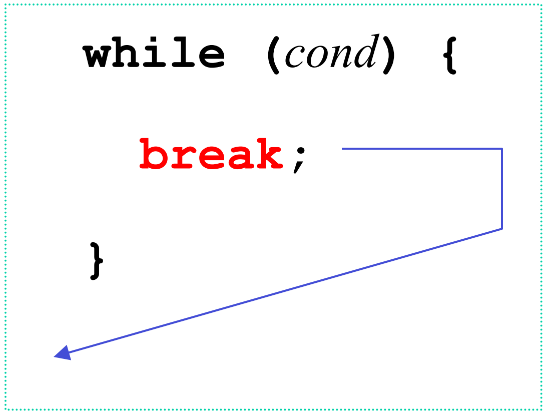
```
for ( init; condition; update ) {
   body
}
```

  - Each section can be blank.
  - Sequence: ① ②③④ … ②③④ ② (cond fails)

`break` Statements

- Exit from a loop
- Typically used with an **`if`** statement

    (as in the previous page)



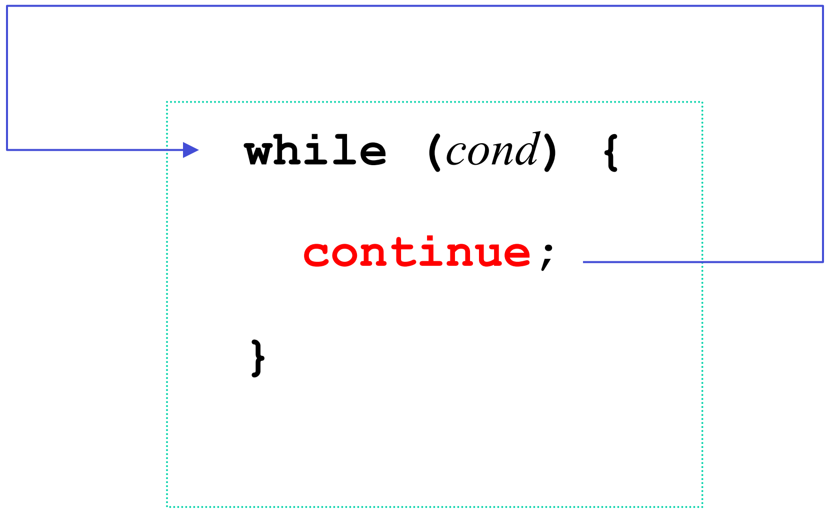
```
while (cond) {
    break;
}
```

Example

```
int i, val;

for(i=1, val=0; i<=100; i++) {
  if (val > 50)
    break;
  val += i;
}
```

`continue` Statements

- Continue to the beginning of a loop
  - I.e., the condition will be checked
- Typically used with an **`if`** statement



```
while (cond) {
   continue;
}
```

Example

```
int i, val;

for (i=1, val=0; i<=100; i++) {
  if (i > 20 && i < 30)
    continue;
  val += i;
}
```

Variations

- No braces

```
int i;
for (i = 0; i < 10; i++)
  printf("%d\n",i);
```

- Omission of component(s)

```
int i = 0;
for (; i < 10;) {
  printf("!");
  i++;
}
```

```
for (;;) {
  printf("!");
}
```

Nested **`for`**

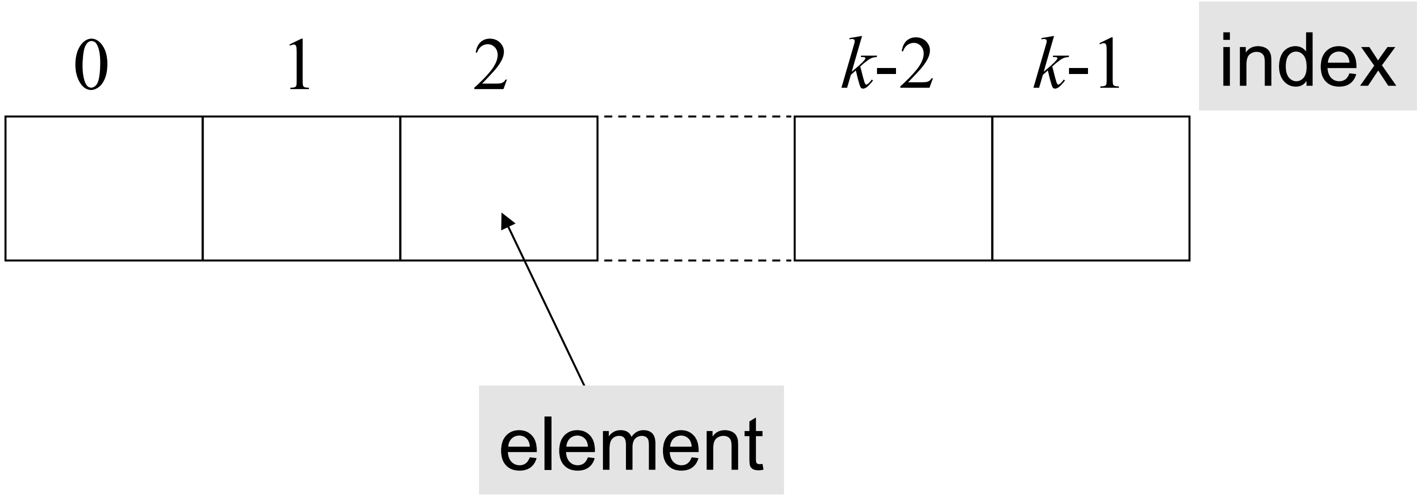
```
int i, j, end = 10;

for (i = 1; i <= end; i++) {
   for (j = 1; j <= i; j++) {
      printf("*");
   }
   printf("\n");
}
```

`triangle.c`

Arrays

Flippo Brunelleschi
Ospdale degli Innocenti
Firenze, Italy, 1421

- To store a large number of data of homogenous type (e.g. `int` only)
- Schematic representation

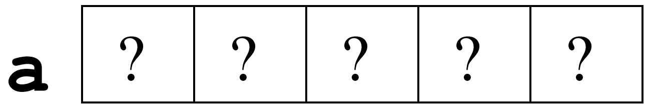


Array Operations

- Declaration

```
int a[5];
```

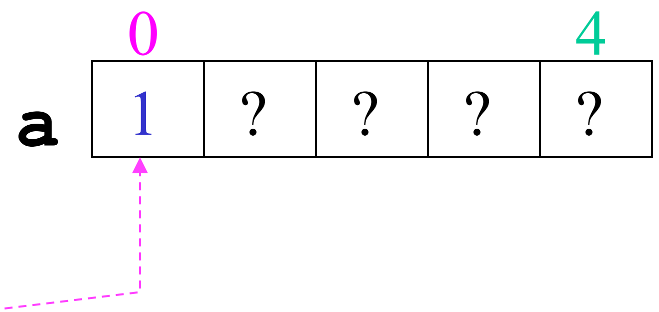
size



- Assignment

```
a[0] = 1;
```

index



- Reference

```
int y = a[0];
```

index

Arrays and Characters

```
int main() {
  int digits[10] = {0}, i; char c;

  while((c = getchar()) != EOF) {
    if (c >= '0' && c <= '9')
      digits[c-'0']++;
  }

  return 0;
}
```

`digitcount.c`

`ctype.h`

- C library containing a bunch of very useful character functions.
- These functions take an integer (not necessarily a **`char`**!) and return **`0`** or **`1`**.
- **`int isdigit(int c);`**
- **`isalpha, isalnum, isspace, islower, isupper`**
- **`int tolower/toupper (int c);`**

`stdlib.h`

- **`void exit(int status);`**
- Terminates a C program.
- Non-zero parameter values indicate program error to parent.
- A call to **`exit(1)`** is often used in conjunction with error detection.

C++: STREAMS AND STRINGS

C++: Streams and Basic I/O

- Files for I/O are the same type of files used to store programs
- A **stream** is a flow of data
  - Input stream: Data flows into the program
    - If input stream flows from keyboard, the program will accept data from the keyboard
    - If input stream flows from a file, the program will accept data from the file
  - Output stream: Data flows out of the program
    - To the screen
    - To a file

C++: cin & cout Streams

- cin
  - Input stream connected to the keyboard
- cout
  - Output stream connected to the screen
- cin and cout defined in the iostream library
  - Use include directive: #include <iostream>
- You can declare your own streams to use with files.

C++ Strings

- Class string
  - Used to represent a sequence of characters as a single object
- Some definitions

```
string name = "Joanne";
string decimalPoint = ".";
string empty = "";
string copy = name;
string question = '?';        // illegal
```

Nonfundamental Types

- To access a library use a preprocessor directive to add its definitions to your program file

```
#include <string>
```

- The *using* statement makes syntax less clumsy
  - Without it

```
std::string s = "Sharp";
std::string t = "Spiffy";
```

  - With it

```
using namespace std; // std contains string
string s = "Sharp";
string t = "Spiffy";
```

Class string

- Some string member functions
  - size() determines number of characters in the string

```
string saying = "Rambling with Gambling";
cout << saying.size() << endl;        // 22
```

  - substr() determines a substring (Note first position has index 0)

```
string word = saying.substr(9, 4); // with
```

  - find() computes the position of a subsequence

```
int j = saying.find("it");           // 10
int k = saying.find("its");          // ?
```

Class string

- Auxiliary functions and operators
  - getline() extracts the next input line

```
string response;
cout << "Enter text: ";
getline(cin, response, '\n');
cout << "Response is \"" << response
 << "\"” << endl;
```

  - Example run

```
Enter text: Want what you do
Response is "Want what you do"
```

Class string

- Auxiliary operators
  - + string concatenation

```
string part1 = "Me";
string part2 = " and ";
string part3 = "You";
string all = part1 + part2 + part3;
```

  - += compound concatenation assignment

```
string thePlace = "Brooklyn";
thePlace += ", NY";
```

datereformat.cpp

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

int main() {
   string date, month, day, year, newDate;
   int i,k;

   cout << "Enter the date (e.g., January 1, 2001) : ";
   getline(cin, date, '\n');

   i = date.find(" ");
   month = date.substr(0, i);

   k = date.find(",");
   day = date.substr(i + 1, k - i - 1);
   year = date.substr(k + 2, date.size() - 1);

   newDate = day + " " + month + " " + year;

   cout << "Original date: " << date << endl;
   cout << "Converted date: " << newDate << endl;
   return 0;
}
```

Summary

- Be careful with prefix and postfix, especially postfix
- Loops are where a program spends most of its time. Learn to write efficient ones!
- Learn to use array and characters flexibly
- Learn to use strings and streams in C++