Week 3 - Wednesday

COMP 2400

Last time

- What did we talk about last time?
- Finished bitwise operations
- Precedence
- Selection statements

Questions?

Project 2

Quotes

Unix is simple. It just takes a genius to understand its simplicity.

Dennis Ritchie

Selection

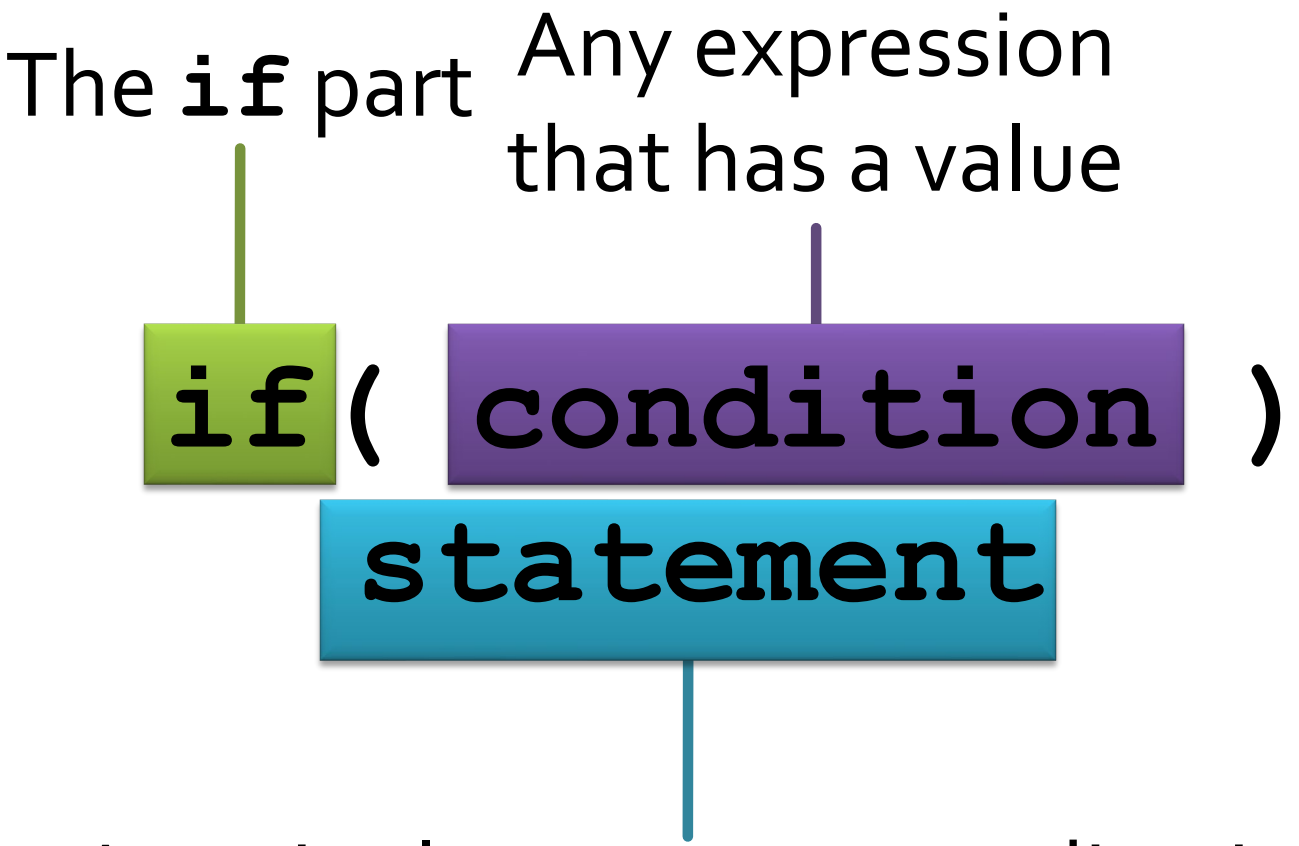
`if` statements

- Like Java, the body of an **`if`** statement will only execute if the condition is true
  - The condition is evaluated to an **int**
  - True means not zero

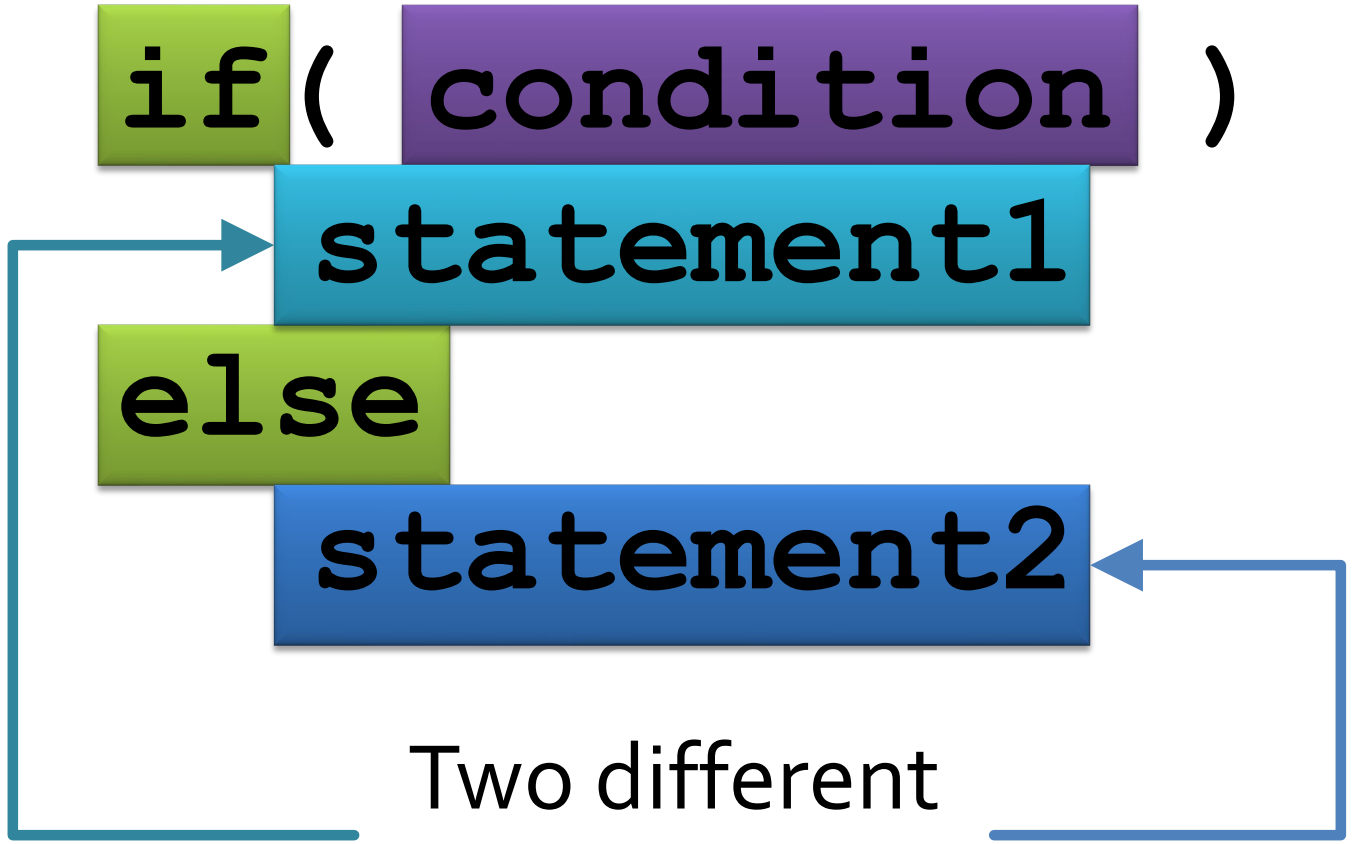
Sometimes this is natural and clear; at other times it can be cryptic.

- An **`else`** is used to mark code executed if the condition is false

Anatomy of an `if`



Anatomy of an `if-else`



Nesting

- We can nest **`if`** statements inside of other **`if`** statements, arbitrarily deep
- Just like Java, there's no such thing as an **`else if`** statement
- But we can **pretend** there is because the entire **`if`** statement and the statement beneath it (and optionally a trailing **`else`**) are treated like a single statement

`switch` statements

- **`switch`** statements allow us to choose between many listed possibilities
- Execution will jump to the matching label or to **`default`** (if present) if none match
  - Labels must be constant (either literal values or **`#define`** constants)
- Execution will continue to fall through the labels until it reaches the end of the switch or hits a **`break`**
  - Don't leave out **`break`** statements unless you really mean to!

Anatomy of a switch statement

```
switch( data )
{
        case constant1:
                statements1
        case constant2:
                statements2
        …
        case constantn:
                statementsn
        default:
                default statements
}
```

Loops

Three loops

- C has three loops, all familiar from Java
  - **`while`** loop
    - You don't know how many times you want to run
  - **`for`** loop
    - You know how many times you want to run
  - **`do-while`** loop
    - You want to run at least once
- Like **`if`** statements, the condition for them will be evaluated to an **`int`**, which is true as long as it is non-zero
  - All loops execute as long as the condition is true

`while` loop

- A **`while`** loop is the keyword **`while`** followed by a pair of parentheses
- Within the parentheses is a condition
- If the condition is true, the body of the loop will be executed
- At the end of the loop, the condition is checked again

Anatomy of a `while` loop

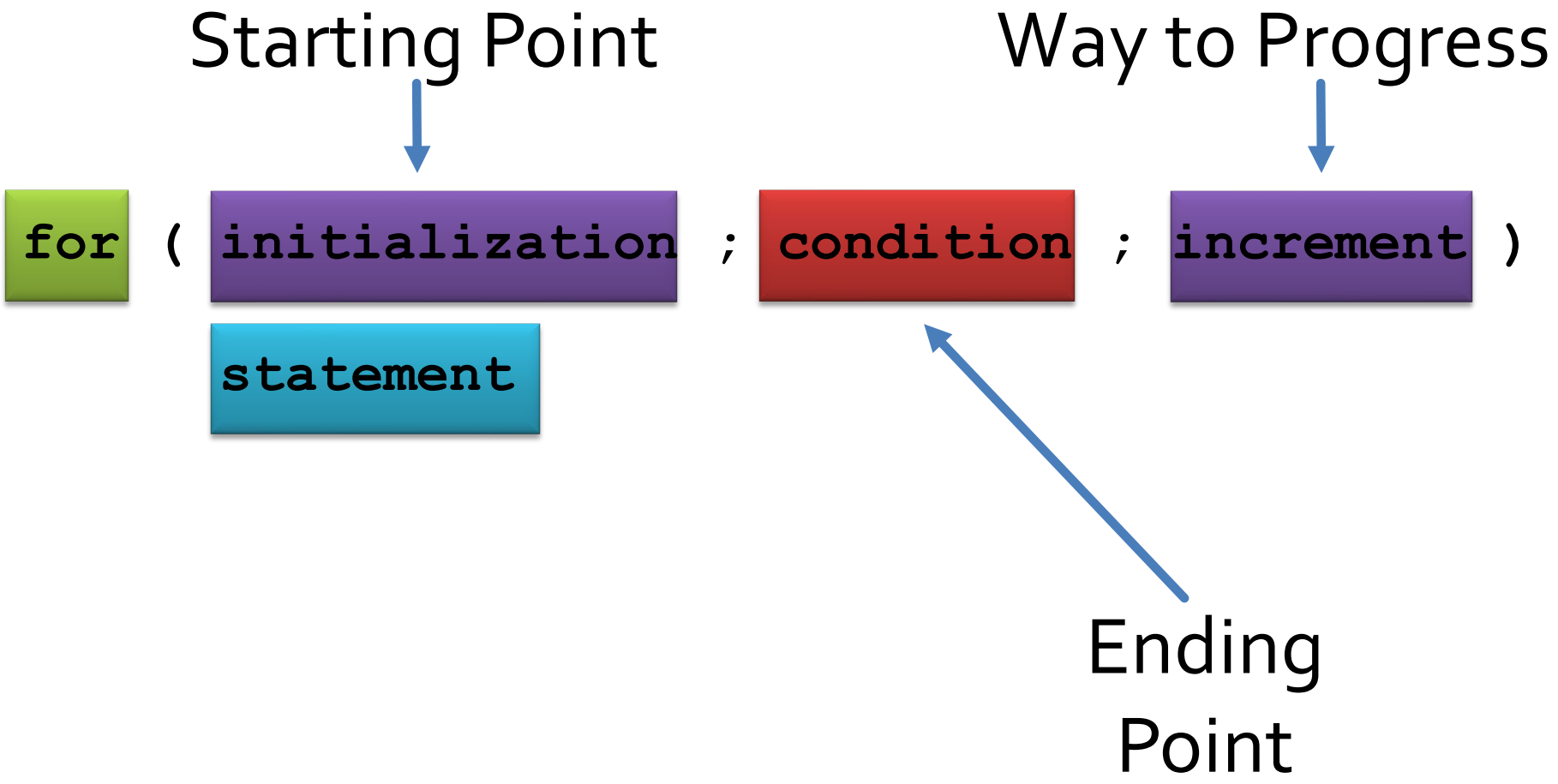
```
while( condition )

    statement
```

`for` loop

- A **`for`** loop consists of three parts:
  - Initialization
  - Condition
  - Increment
- The initialization is run when the loop is reached
- If the condition is true, the body of the loop will be executed
- At the end of the loop, the increment will be executed and the condition checked again
  - If the condition is empty (nothing in it), it is considered true

Anatomy of a `for` loop



The comma operator

- C has a comma operator
- Expressions can be written and separated by commas
- Each will be evaluated, and the last one will give the value for the entire expression

```
int a = 10;
int b = 5;
int c = (a, b, ++a, a + b); //16
```

Adding the comma to `for`

- Sometimes you want to do multiple things on each iteration
- Consider this code to reverse an array

```
for(int start = 0, end = length - 1; start < end; start++, end--)
{
     int temp = array[start];
     array[start] = array[end];
     array[end] = temp;
}
```

- You can even use a comma in the condition part, but it doesn't usually make sense

`do-while` loops

- As in Java, there are **`do-while`** loops which are useful only occasionally
- They work just like **`while`** loops except that that they're guaranteed to execute at least once
- Unlike a **`while`** loop, the condition isn't checked the first time you go into the loop
- Sometimes this is useful for getting input from the user
- **Don't forget the semicolon at the end!**

Anatomy of a do-while loop

```
do
    statement
while( condition );
```

Duff's device

- C has relatively relaxed syntax rules

```
int n = (count + 7) / 8;
switch (count % 8)
{
      case 0: do {  *to++ = *from++;
      case 7:       *to++ = *from++;
      case 6:       *to++ = *from++;
      case 5:       *to++ = *from++;
      case 4:       *to++ = *from++;
      case 3:       *to++ = *from++;
      case 2:       *to++ = *from++;
      case 1:       *to++ = *from++;

      } while (--n > 0);
}
```

- What the hell is that?!

Practice

- Use the loop of your choice to count the number of 1 bits in an unsigned int value
- You pretty much have to do this on Project 2

Common Loop Errors

Infinite loops

- Loops can go on forever if you aren't careful

```
int n = 40;
int i = 1;

while (i <= 40)
{
  printf ("%d", i);
  // Supposed to print all the numbers
  // less than 40, but i never increases
}
```

Infinite `for` loops

- Infinite **`for`** loops are unusual, but possible:

```
for ( ; ; )
  printf("Hey!");
```

- This situation is more likely:

```
for (int i = 0; i < 10; ++i)
{
  printf("%d", i);
  // Lots of other code
  --i; // Whoops, maybe changed from while?
}
```

(Almost) infinite loops

- Overflow and underflow will make some badly written loops **eventually** terminate

```
for (int i = 1; i <= 40; --i)
 // Whoops, should have been ++i
 printf("%d", i);
```

Fencepost errors

- Being off by one is a very common loop error

```
for (int i = 1; i < 40; ++i)
  // Runs 39 times
  printf("%d", i);
```

Skipping loops entirely

- If the condition isn't **`true`** to begin with, the loop will just be skipped

```
for (int i = 1; i >= 40; i++ )
  // Oops, should be <=
  printf("%d", i);
```

Misplaced semicolon

- A misplaced semicolon can cause an empty loop body to be executed

```
int i;
for (i = 1; i <= 40; i++); // Semicolon is wrong
{
  printf("%d", i);
}
```

- Everything looks good, loop even terminates
- But, only one number will be printed: 41
- Misplaced semicolon usually makes a **`while`** loop infinite

Ticket Out the Door

Upcoming

Next time…

- **`break`** and **`continue`**
- System calls

Reminders

- Keep reading K&R chapter 3
- Read LPI chapters 2 and 3
- Work on Project 2