CSE 374: Programming Concepts and Tools

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Lecture 9: intro to C

Administrivia

- Homework 2 turned in
- Homework 3 out this afternoon: start early!
  - Ramp up again from HW2
- How’s everything going?

Where we are

- We've just set out to C
- Today we're going to learn to navigate more of the language
  - Control Structures, Boolean Expressions, Null
  - Declarations and Definitions, Forward References, Array Declarations, Pointer Declarations
  - C Preprocessor
  - `printf` and `scanf`, convenient IO

Control in C

- `if (<expr>) { <body> }`
- `if (<expr>) { <body> } else { <body> }`
- `while (<expr>) { <body> }`
- `do { <body> } while (<expr>)`
- `for (<init>; <expr>; <stmt>) { <body> }`
- `continue; break; switch…`

Expressions

- There is no boolean type in C
- Instead, everything is true, except 0 and `Null`
- People have added their own boolean libraries, but nothing has stuck
- Same comparison operators as Java: `<, >, <=, >=, ==, !=`
- You can also use a number as a boolean (or negate it with `!`)

Examples

- Loop 100 times

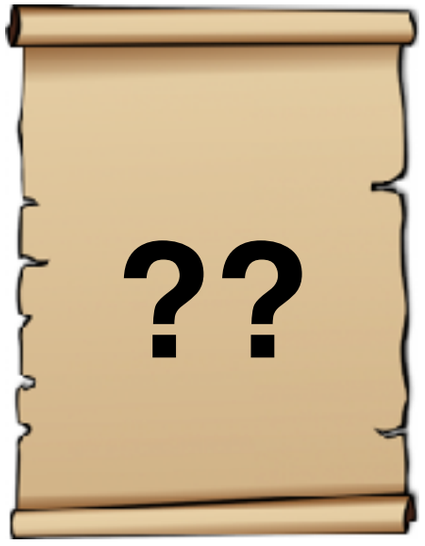
```
for (int i = 0; i < 100; i++) {
    printf("%d\n", i); //print out value of i
}
```

- Do something if x is not Null

```
if (x) {
    <something>
}
```

`Null`

- What is it? Nothing
- It's the value stored in a pointer which points nowhere
- ***NEVER*** dereference `Null`
- Used to denote "nothing's here"
- Think of it as a blank treasure map, leading nowhere



Declarations/Definitions

- Declaration
  - Telling the world something is there
  - Only concerned with external shape, or type
  - As many times as you want (but only once per file/scope)
- Definition
  - Filling in the internal bits
  - Only once

Functions

- Declaration

```
int twice(int x);
```

- Definition

```
int twice(int x) {
    return 2 * x;
}
```

Forward References

- Anything you use must be declared before use
- (Defining counts as declaring)
- ***Cannot*** have forward references:

```
int main(int argc, char* argv[]) {
    int y = twice(argc);
    printf("%d\n", y);
}
int twice(int x) {
    return 2 * x;
}
```

How to structure a file

- If you have 2 functions f and g, and f calls g, define g before you define f
- If they need to call each other, you have to declare one before defining it

Classic C

- In old classing C, all variable declarations need to come at the beginning of a block
- Thankfully that is no longer the case
  - Ignore your book on this one

Array Declarations

- Uninitialized Arrays:

```
int n[10];

char buffer[128];
```

- Initialized Arrays:

```
int n[3] = {0,0,0};
```

- As Function Parameters:

```
int sum(int x[], int x_length) { … }
```

Actually a pointer

Multiple Declarations

- You can put multiple declarations on one line
- e.g. `int x, y, z;`
- This will get you in trouble fast!
- e.g. `int* x, y, z;`
- One declaration per line, *especially* if it's a pointer type

C Preprocessor

- Rewrites your files before the compiler gets code
- Everything that starts with #
- This can do normal and crazy things
  - Please stick to the more normal
    1. Include header files (Today)
    2. Define constants (Today) and parameterized macros (Later)
    3. Conditional compilation (Later)

#include

- `#include <foo.h>`
  - Look for foo.h in “system directories”, find and preprocess contents (recursion), and paste results literally (as a string) into this file
- `#include “foo.h”`
  - Same as above, but look in current directory first
- `gcc -I dir1 -I dir2` will pass in search directories for header files (we won’t need in this class)

Macros and Constants

- #define replaces *tokens* in the rest of the file
  - Knows where words (tokens) start and end (unlike sed)
  - No notion of scope

```
#define foo 17
void f() {
 int food = foo; //int food = 17;
 int foo = 9+foo+foo; //int 17 = 9+17+17;
}
```

printf and scanf

- “Just” two library functions
  - Declared in <stdio.h>
- Used to print to stdout and read from stdin
- They can take any number of arguments
- The “f” in name stands for formatted

printf and scanf

- Number of arguments better match number of % in format string
- Corresponding arguments better have the right type
  - For scanf must be pointer type (int* for %d, still char* for %s)
- Compiler probably won't check for you
- If you don't follow rules, hopefully you crash soon, but who knows?

printf and scanf

- Many different formatting options
- Read documentation to find all of it
  - Padding, precision, left/right, decimal/hex, etc…
- You ***must*** check scanf to see if it worked
  - input may not have matched text
  - maybe some number typed in not a number

scanf

- scanf looking for a string (%s) will read until whitespace, and write into provided string
  - If you don’t have enough space, it will overwrite something else
  - You can limit it with %20s or %45s
  - The number given is number of characters, you still need more room for ‘\0’ terminator