CSE 303 Concepts and Tools for Software Development

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UW CSE – 10/13/2006

Lecture 8 –
C Program Structure and Syntax

Administravia

- Reading Assingnments on Web
- HW3 Announced on Wed.

Tip of the Day

- Try stuff out!
  - Run lecture examples
    - Tweak them to try new things
  - Make example programs
    - For things you don't understand
  - Try "interesting" exercises in book
    - If you don't know where to begin

Remember, you're learning to teach yourself

Last Time

- C Memory Model
- Simple C Programs
- Introduction to Pointers

Today

- C-Program Structure
  - Declarations and Scope
  - Argument Passing
- Syntax
  - Booleans and arrays
  - Confusing Cases
- Printf

Storage Duration and Scope

- Define or declare everything before using
- Scope
  - Global variables: outside function
  - Local variables: inside function
- Storage class (lifetime)
  - Globals exist for duration of program
  - Locals exist while their block is active
  - Static locals retain value between invocations
- Examples in *declare.c*

Structure of a C Program

```
// First include all header files (more later)
#include <stdio.h>

// Declare global variables (avoid if you can!)
int myVar_g;

// Function must be declared before it is used
void my_function(int a, int b);

int main() {
   my_function(2,3);
   return 0;
}

void my_function(int a, int b) { ... }
```


Argument Passing

- All Arguments Passed by Value
  - Function receives copy of argument
  - Chances to copy won't affect original
- You can still modify an argument
  - Using pointers (see *pointerArg.c*)
  - *References* introduced by C++
- Examples in *pointerArg.c*

Syntax: Data Types

- Variables
  - Same as Java (`int`, `float`, `double`, etc.)
  - `bool` is a recent addition to C
    - Requires `#include <stdbool.h>`
    - Examples in *bool.c*
- Arrays
  - Size: constant expression only
  - Funny rules for use (more later)
  - Examples in *arrays.c*

Syntax: Control Constructs

- Very similar to Java
  - `while`, `if`, `for`, `switch`
  - `break`, `continue`
- Some ugly additions
  - `goto` :jump to any location
  - Hard to reason about, but handy sometimes
  - More general than Java's labeled break

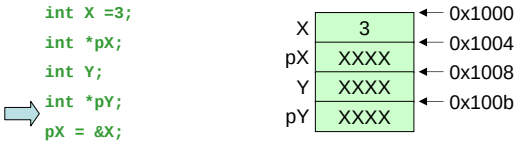
Confusion: Left vs. Right Exprs.

- In Assignment (`left = right;`)
  - Left is evaluated to location (address)
  - Right is evaluated to value
  - Values include numbers and pointers
- Key difference
  - Left: variable gives location
  - Right: evaluated from data in variables
  - Note: same as Java

Left vs. Right

Examples

```
int X =3;
int *pX;
int Y;
int *pY;
pX = &X;
pY = pX;
pY = &Y;
*pY = *pX;
```



Left vs. Right

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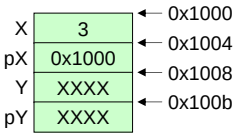

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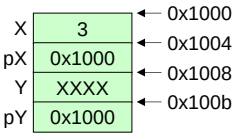

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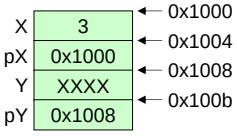

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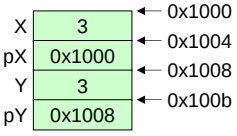

NULL Pointers

- Pointer to NULL means “nothing”
- NULL defined in <stdio.h>
  - Actual value is zero
- Dereferencing causes crash
- Examples in *pointer.c*

Confusion: Dangling Pointers

- Pointer initialized to address
- Storage for that address is reclaimed
  - Lifetime of variable ended
  - Explicitly de-allocated (we’ll see this later)
- The pointer is left “dangling”
  - Points to undefined location
  - Will crash *if you’re lucky!*
  - Usually *subtle and silent bugs*.
- Exampes in *dangling.c*

Confusion: C99 Standard

- Revisions to C language in 1999
- Not fully supported in our gcc
  - Some require additional flag `-std=c99`
    - *E.g.* declaring variables in `for` (see *arrays.c*)
  - Some just not supported
    - *E.g.* variable-length arrays
- Know the capabilities of your compiler
- *Programming in C assumes C99!*

Confusion: Other

- Variable declarations are funky
  - Can have multiple on one line
    - `int x, y;` or `int x=0, y;` or `int x, y=0;`
  - Pointers have confusing syntax
    - `int *x, y;` : "y" is type `int y;` not `int *y;`
- Implicit declarations
  - Function assumed to return int if not declared
  - Can result in "linker error"

Printf

- `printf("format", v1, v2, …);`
- Most Common Formats
  - `%d` : int
  - `%f` : float, double
  - `%c` : char
  - `%s` : char* (strings)
  - `%x` : hexadecimal
- Examples in *format.c*

Summary

- C-Program Structure
  - Declarations and Scope
  - Argument Passing
- Syntax
  - Booleans and arrays
  - Confusing Cases
- Printf

Reading

- Programming in C
  - Skim Chapters 4-6
    - Only if you need to refresh your memory of Java
  - Chapter 8: Functions
  - Chapter 11:
    - pp235-240: Pointers in expressions
    - pp254-259: Pointers and Functions
    - pp272: Operations on Pointers
    - pp274-276: Pointers and Memory Addresses

Next Time

- Arrays
- Strings
- Command Line Arguments