CSE 374 Lecture 9

Declarations, control, printf

Hello World in C

```
#include <stdio.h>

/**
 * Compile this file with:
 *     gcc -o hello hello.c
 */
int main(int argc, char **argv)
{
  printf("Hello, World!\n");
  return 0;
}
```

- ➔ Compile: `gcc hello.c`
  - ◆ creates executable `a.out`
- ➔ Or: `gcc -Wall -std=c11 -o hello hello.c`
  - ◆ Wall - turns all warnings on
  - ◆ C11 - specifies using C11 standard libraries
  - ◆ Creates executable `hello`
- ➔ Run: `./a.out` or `./hello`
  - ◆ Exits with ‘0’ (`return 0;`)

Source File Structures

```
// includes for functions & types
defined elsewhere
#include <stdio.h>
#include "localstuff.h"
// symbolic constants
#define MAGIC 42
// global variables (if any)
static int days_per_month[ ] = { 31,
28, 31, 30, …};
// function prototypes
// (to handle "declare before use")
 void some_later_function(char, int);
// function definitions
void do_this( ) { … }
char *return_that(char s[ ], int n)
{ … }
int main(int argc, char ** argv) { … }
```

Preprocessor

Pre-processes your C code before the compiler gets to it.

- ➔ Follows commands prefaced by '#'
- ➔ Includes content of header files
- ➔ Defines constants and macros
- ➔ Conditional compilation (not covered right now)

File inclusion

- ➔ #include <foo.h>
  - ◆ Searches for foo.h in "system include" directories (/usr/include, etc)
- ➔ #include "foo.h"
  - ◆ Starts by searching in current directory (allows coder to break project into smaller files)
- ➔ Include include file's preprocessed contents
- ➔ Recursively include all the includes from original file
- ➔ Use gcc -l dir1 to tell gcc to look for include in dir1

Preprocessor Cont.

Define constants

```
#define PI 3.14
#define NULL 0 // in stdlib

#define TRUE 1
#define FALSE 0
```

And macros

```
#define min(X, Y)  ((X) < (Y) ? (X) : (Y))
```

Constants are ALL_CAPS to differentiate them from other variables.

Defined constants will override variables of the same name used in the code.

Shadow with another #define, or, #undef

Declarations Cont.

You can put multiple declarations on one line, e.g., int x, y; or int x=0, y; or int x, y=0;, or …

But int *x, y; means int *x; int y; – you usually mean (want) int *x, *y;

Common style rule: one declaration per line (clarity, safety, easier to place comments)

Array types in function arguments are pointers(!)

Definitions

Defines properties of item; this happens only ONCE, even if the item is declared more than once.

Linker-error will occur if an item is used but not defined.

To use something before it is defined, you must declare it before you use it (forward declaration).

```
int count=4

countptr = &count;

int count[3] = {1,2,3};

int adding(int a, int b) {
    return (a+b);
}


void printing (char *str){
    printf("%s\n", str);
}
```

L-values v. R-values

Left Side

Right Side

Evaluated to values (the contents at the address)

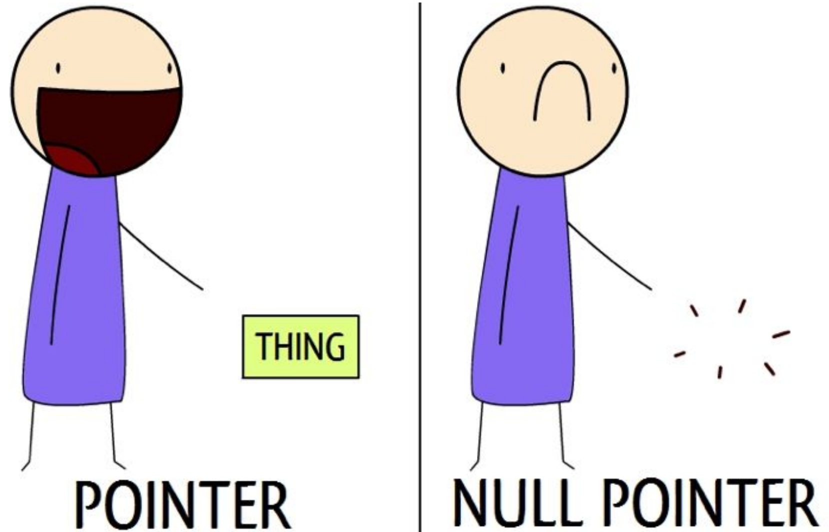
Values may be numbers (or characters) OR addresses

```
9 = x;     // Nonsense, because 9 isn't a LOCATION
int x = 1; // Stores the VALUE 1 at a LOCATION which has the LABEL x.
x = 2;     // Stores the VALUE 2 at the LOCATION x.
int* xPtr = &x;  // Stores VALUE of address of x at a LOCATION labelled xPtr.
*xPtr = 3;  // Stores VALUE 3 at a LOCATION defined by address stored in xPtr.
int** xx = &(&x);// Nonsense, the r-value needs to resolve to a value.
                 // &x does indeed represent a value (the address x), but
                 // &(&x) refers to the address of the address of x -
                 // which is just a number and not stored anywhere
```

Definitions

- Int *arrspace = myArr;
- Arrays that rely on run-time info to determine size are dynamically allocated to the heap (and declared *array syntax)
- Define as NULL until otherwise defined.

https://www.codewithc.com/understanding-c-pointers-beginners-guide/



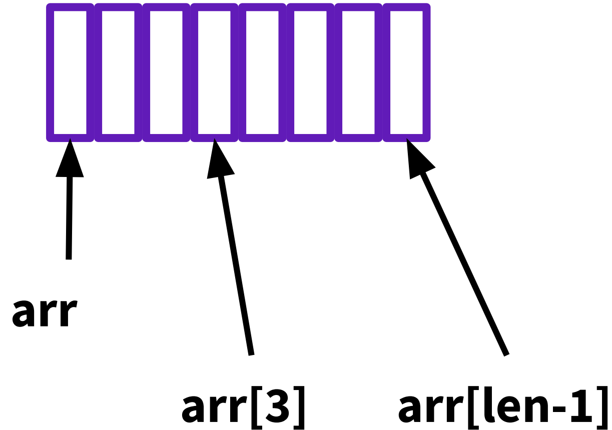
Initialization

Memory allocation and initialization are not the same thing

Unlike Java, you MUST provide a value to initialize a bit of memory

It is possible to access un-initialized bits
unlike Java which sets defaults and checks for initialization
best case scenario: you crash

Arrays



- int myArr[10];
  - User must store length (10).
- Int *arrspace = myArr;
  - Implicit conversion
- myArr[3] is ??
  - (Not automatically initialized to any value.)
- Arrays MUST be declared with a constant length (the compiler needs to allocate space)
- Arrays that rely on run-time info to determine size are dynamically allocated to the heap (and declared *array syntax)

Arrays

Contiguous blocks in memory

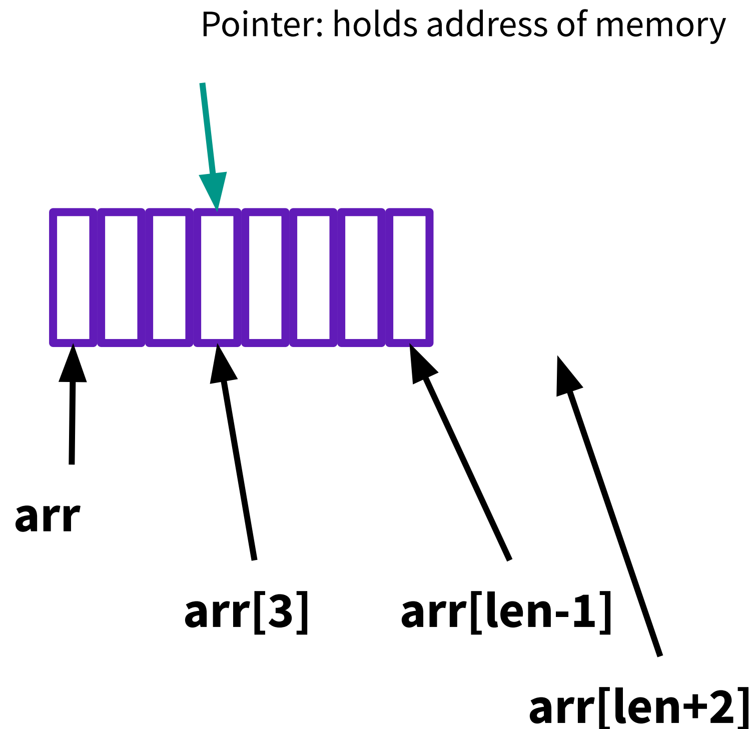
Declare as

```
Datatype arr[len]
```

Has type

```
Datatype*
```

Stores the location in memory of the first value; when arrays are passed passes this memory location



Danger, Will Robinson!!

Control constructs

Similar to Java: if, while, switch

Break, continue, etc.

https://www.gnu.org/software/gnu-c-manual/gnu-c-manual.html#Statements

No Boolean type!

Use integers, can declare constants.

Generally, 0/NULL => False

Anything else => True

Or #include <stdbool.h>

I/O : Printf, scanf

Printf and scanf are two I/O functions, prototyped in stdio.h

- Printf (print-format)
- int printf(const char *format, ...)
- ‘Format’ is a string that can contain format tags
- + additional arguments to match tags
- Number of arguments better match number of %
- Corresponding arguments better have the right types (%d, int; %f, float; %e, float (prints scientific); %s, \0- terminated char*; … Compiler might check, but not guaranteed
  - best case scenario: you crash
- `printf("%s: %d %g\n", p, y+9, 3.0)`

- scanf (gets input, formatted)
- int scanf(const char *format, ...)
- ‘Format’ is a string that can contain format tags
- + additional arguments to match tags - should be pointers to the right data type so input can be stored in them
- `scanf(“%d %s”, &n, str);`
- `scanf("%*s %d", &a);`
  - %*s ignores string until space, then reads in an integer