# Introduction to Computer Science W 1113 – Lab (C) Lab9

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## Questions about HW4



## Recap from Lab 7

- Writing a README and comments
- Function prototypes (but I am still not sure everyone gets it)
- Preprocessors
  - #include
  - #define
- Bit Operators
- Debugging

## Recap from Lab 8

- preprocessors
- struct
- union
- typedef
- enum

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## Pointer Basics

- A pointer is a variable in C that contains a memory location.
- Pointers are used in programs to access memory and manipulate addresses.
  - We have already seen it briefly in scanf() where usage was scanf("%d", &v);

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## Pointer Basics II

- Declaration
  - int *p;
  - This creates 'p', which is of type "pointer to int"
  - The legal range of values for any pointer always includes the special address 0 and a set of positive integers that are interpreted as machine addresses on the system
- & is used to "point to" the address of a variable
  - This is used to dereference a variable's memory location
  - Officially - & is an operator that retrieves the memory address of a variable

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## Pointer Basics III

- Examples
  - p = &i; // p has the memory location of i
    // therefore *p points to i
  - p = 0; // shows assignment of p to 0
  - p = NULL; // same as p = 0;
  - p = (int *) 1307; // p now has an absolute
    // address in memory
    // We do this by using a cast
    // This is typically not done, why?

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## Pointer Basics IV

- Typical example (ptrexample0.c)

```
int var;          // Declare an integer var
int *p;           // Declare p as a pointer to an integer

var = 4;          // Set the value of var to be 4
p = &var;         // Set p to be the address of var

printf ("%d", p); // Is this accurate?

*p = 5;           // Sets the value of the thing p is pointing to, to 5
p = 5;            // What will this do?
```

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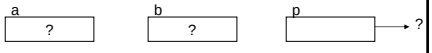
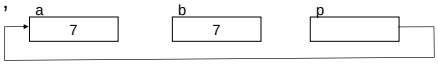
## Pointer Addressing/Dereferencing

int a, b;
int *p;




a = b = 7;
p = &a;




printf("%d\n", *p); // What is printed?

*p = 3;
printf("%d\n", a); // What is printed?

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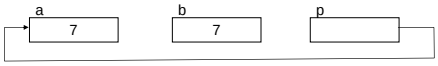
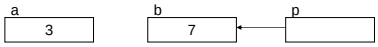
## Pointer Addressing/Dereferencing




p = &b;




*p = 2 * *p – a;
printf("b = %d\n", b); // What does this print?

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## * and & relationship

- Simply put, the dereference operator (*) is the inverse of the address operator (&).

```
double x, y, *p;

p = &x;
y = *p;

// Here, p is assigned to address of x. Then y is assigned to the
// value of object pointed to by p

y = *&x;
y = x;
//How do these two statements relate to the above two?
```

(ptrexample1.c)

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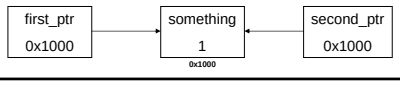
## Multiple pointers can point to one location

```
int something;

int *first_ptr;
int *second_ptr;

something = 1;

first_ptr = &something;
second_ptr = first_ptr;
```

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## Convince yourself

| Declarations and Initializations | | |
|---|---|---|
| int | i=3, j=6, *p=&i, *q=&j, *r; | |
| double | x; | |
| Expression | Equivalent Expression | Value |
| p == &i | p == (& i) | 1 |
| p = i + 7 | p = (i+7) | illegal |
| * * & p | * (* (&p)) | 3 |
| r = &x | r = (&x) | illegal |
| 8 * * p / * q + 7 | (((8 * (* p)) / (* q)) + 7) | 11 |
| * (r = &j) *= *p | (* (r = (&j))) *= (*p) | 18 |

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## Call by reference

- Pointers can be used as function arguments
- We have been typically using call by value
- Remember the swap function

```
#include <stdio.h>

int swap (int a, int b);
int main () {
        int x=3, y=7;
        printf("%d %d\n", x, y);
        swap (x,y);
        printf("%d %d\n", x, y);
        return 0;
}

int swap (int a, int b) {
        int tmp;
        tmp=a;
        a=b;
        b=tmp;
        return a;       // I can return only one value, what do I return?
} //ptrexample2.c
```

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## Call by reference II

- Note that the call-by-value has problems in that only the method's local values are affected.
- Therefore we need something else
  - Pointers to the rescue
  - We call other functions and pass parameters by reference
  - New code looks like

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## Call by reference III

```
#include <stdio.h>

int swap (int *, int *);

int main() {
        int x=3, y=7;

        printf("%d %d\n", x, y);

        swap (&x,&y);
        printf("%d %d\n", x, y);
        return 0;
}

int swap (int *p, int *q) {
        int tmp;

        tmp = *p;
        *p = *q;
        *q = tmp;
}
//ptrexample3.c
```

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## Call by reference IV

- Another example

```
#include <stdio.h>

void inc_count (int *count_ptr)

int main () {
        int count = 0;

        while (count < 10)
                inc_count(&count);

        return 0;
}

void inc_count(int *count_ptr) {
        (*count_ptr)++;
}
```

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## Assignment

- Read Ch. 13 from the Practical C Programming book
- **HW4**

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