ECS 36A, April 11, 2024

Announcements

- Be sure you use this command to run your program in the CSIF before submitting it to Gradescope:

```
gcc –ansi –pedantic –Wall filename.c –o filename
```

- Some compilers allow // to comment out the rest of the line
    - Not part of the C90 standard

Announcements

My office hours:

- Tuesday 12:30pm–1:30pm, 2203 Watershed Sciences
- Wednesday 12:00pm–1:00pm, 2203 Watershed Sciences
- Friday 1:00pm–2:00pm, 2209 Watershed Sciences
  - I'm trying to get 2203 Watershed Sciences and will post an announcement if/when I do

Detail of –53 Being unsigned int 429496724

- Assume we are working on a 32-bit system
- Here is –53 represented as a 32-bit number:

  11111111111111111111111111001011

- But if you read it as unsigned, this represents a *positive* number, here 4294967243
- Why? Because it is represented as 2^{32} – 53, not 53.

Functions

- Perform some task the program will do repeatedly
- Helpful for organizing programs
- Improves readability

Format

- Here is a function definition:

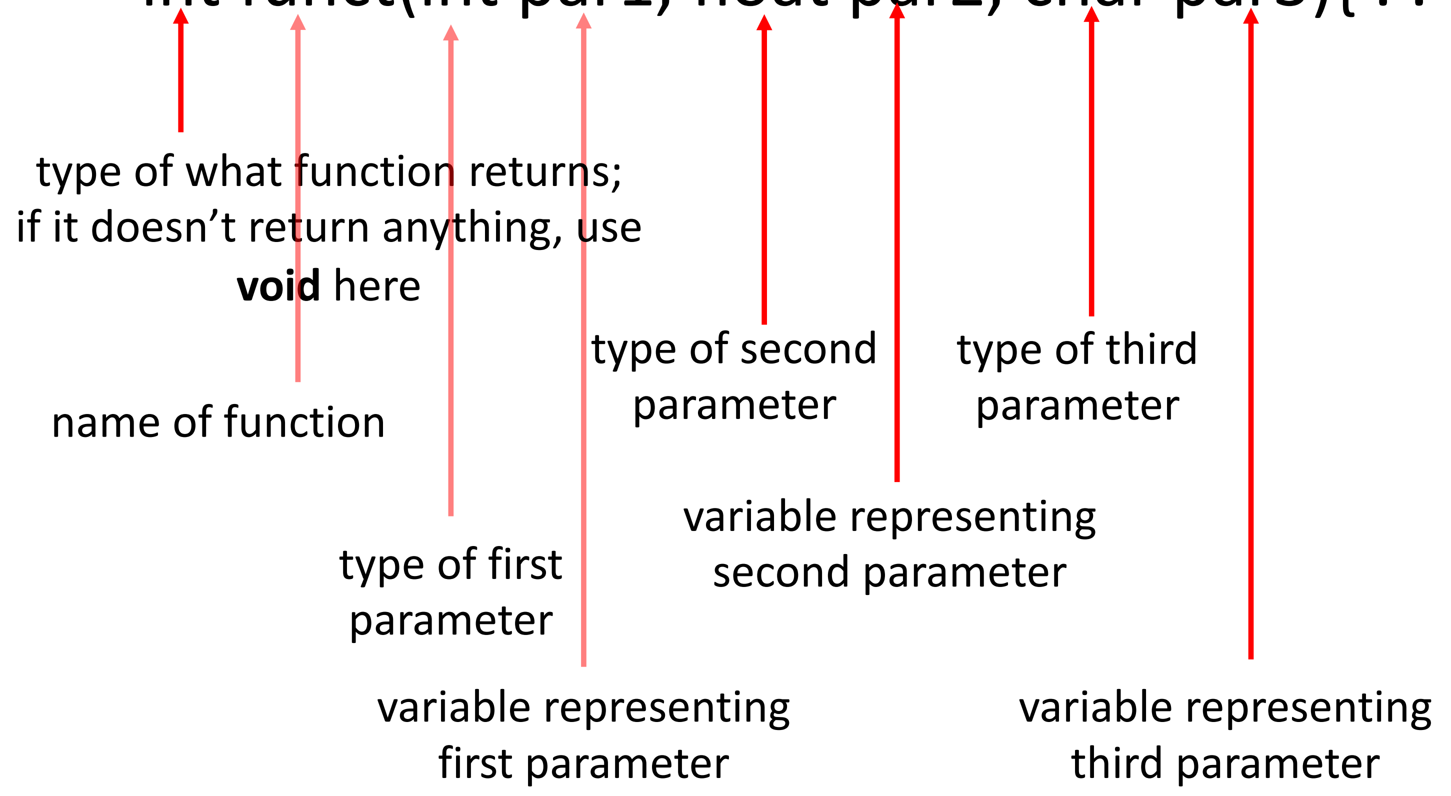
```
int add17(int num){
       int y;        /* used to hold sum */
       y = num + 17;
       return(y);
}
```

- Here is a function call:

```
. . .
       sum1 = add17(53);
. . .
       sum2 = add17(-12);
. . .
```

In Detail – Function Definition

```
int funct(int par1, float par2, char par3){ . . .
```


type of what function returns;
if it doesn't return anything, use **void** here
name of function
type of first parameter
variable representing first parameter
type of second parameter
variable representing second parameter
type of third parameter
variable representing third parameter

In Detail – Function Call

```
int x;
float fx;
x = funct(7, fx, ‘a’);
```

variable holding return value of function

function call

first argument

second argument

third argument

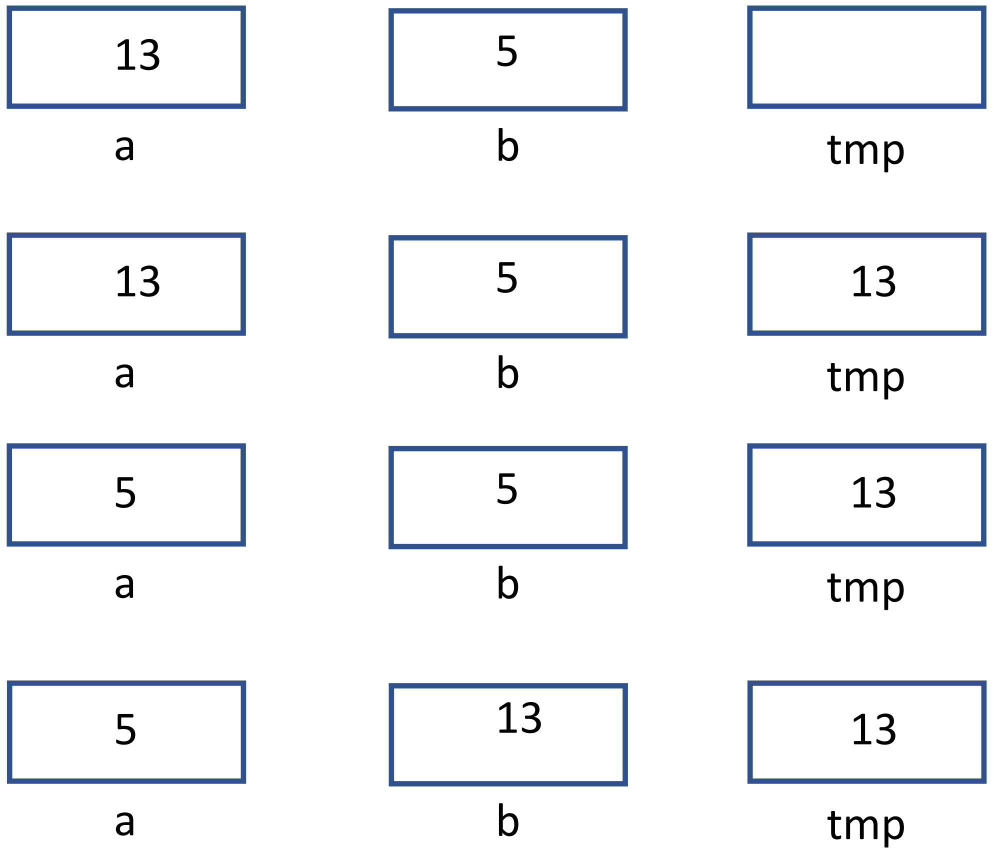
- Arguments are matched with parameters in order
- Here, from previous slide:
  - par1 is 7
  - par2 is the value contained in fx
  - par3 is ‘a’
- Note parameter types matches argument types

Prototypes or Forward Declarations

- Functions must be declared before use
- If defined before use, the function type, name, and parameter list serves as the declaration
- If defined *after* use, compiler makes assumptions about the types of parameters and function
    - And gcc will give you a warning
- A function prototype looks exactly lke the first line of a function definition
    - int funct(int par1, float par2, char par3);
    - Note the “;” at the end!

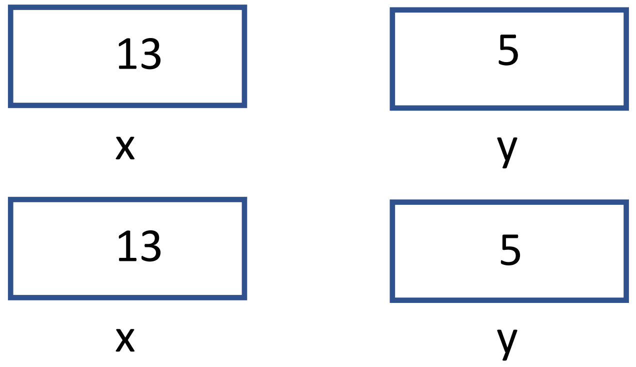
More About Functions

```
void swap(int a, int b)
{
        int tmp;

        tmp = a;
        a = b;
        b = tmp;
}
```



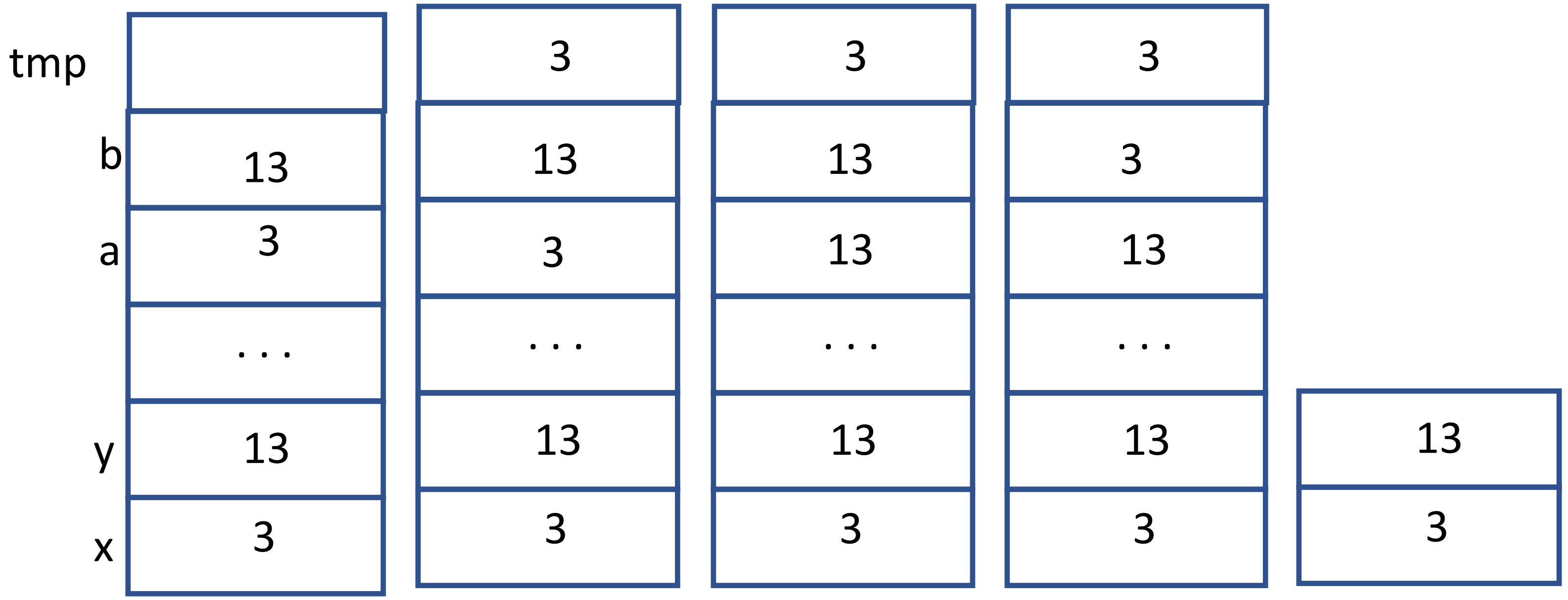
And On The Calling End

```
x = 13;
y = 5;
printf("x = %d, y = %d\n", x, y);
swap(a, b);
printf("x = %d, y = %d\n", x, y);
```



The Stack

```
void swap(int a, int b)
{
        int tmp;

        tmp = a;
        a = b;
        b = tmp;
}
. . .
x = 3; y = 13;
swap(x, y);
. . .
print("x = %d; y = %d\n", x, y);
```



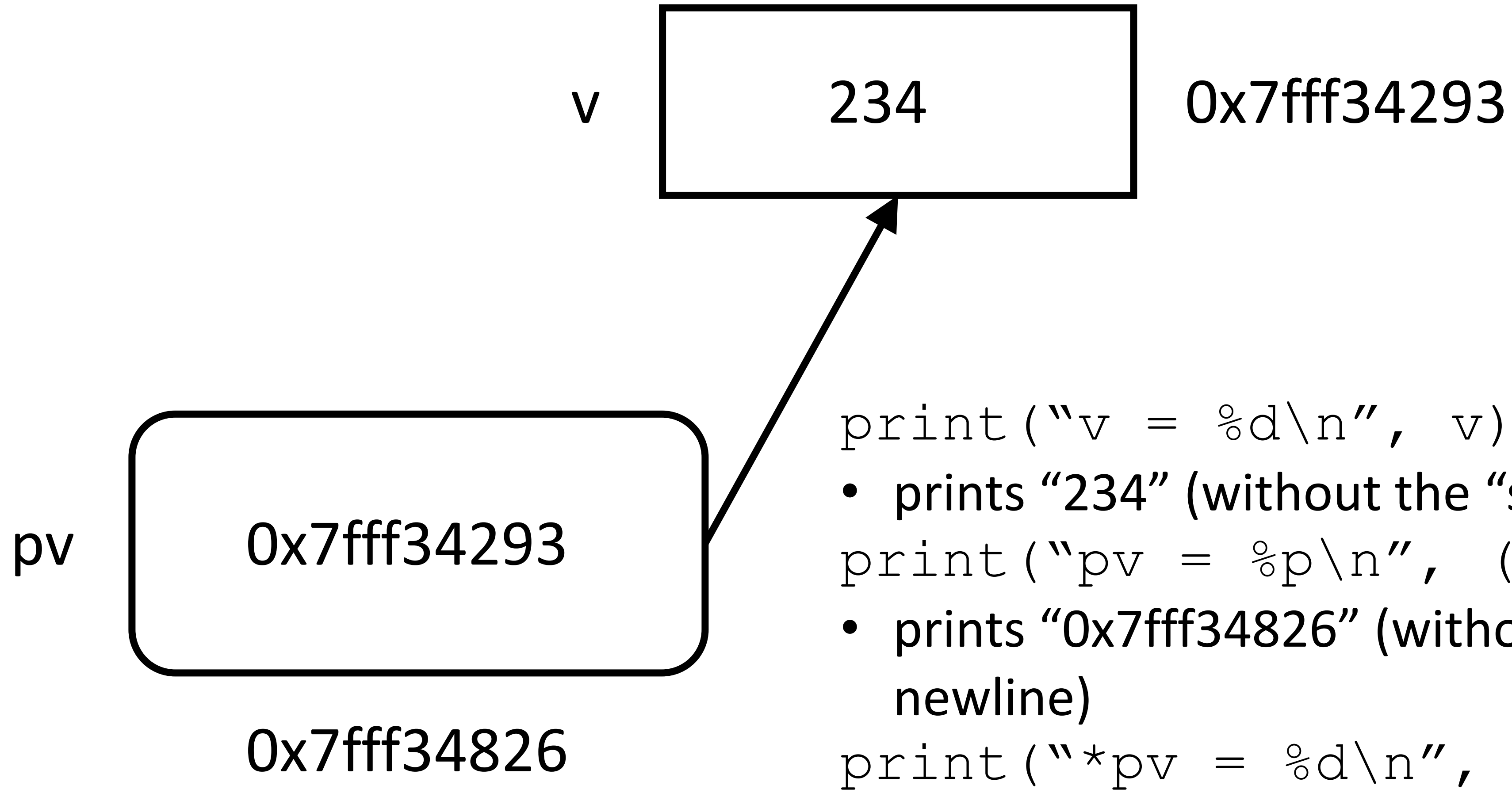
Pointers

- A variable containing the address of another variable
- Example:

```
int x = 0;
int *px;
px = &x;
printf(“x = %d, px = %p, *px = %d\n”, x, (void *)px, *px);
```

- Operators:
  - &*variable*: address of *variable*
  - **variable*: what is in the memory location with the address stored in *variable*

In Pictures



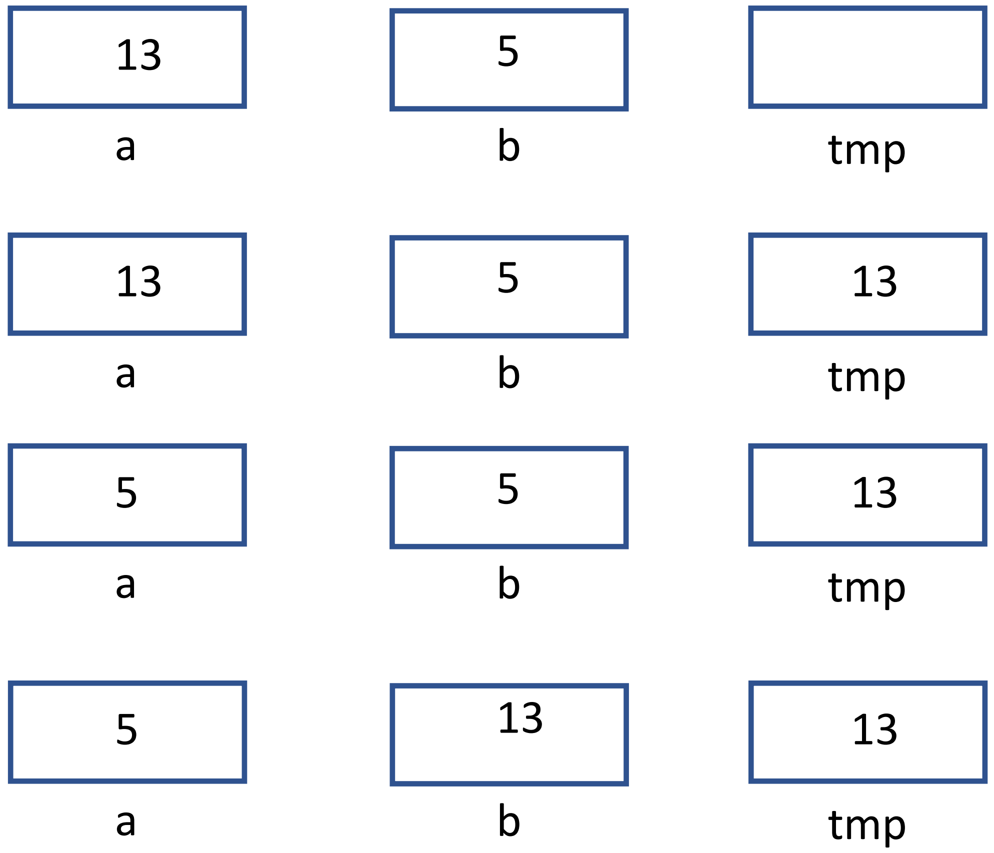
```
print("v = %d\n", v);
```
- prints "234" (without the "s, ending in newline)

```
print("pv = %p\n", (void *)pv);
```
- prints "0x7fff34826" (without the "s, ending in newline)

```
print("*pv = %d\n", *pv);
```
- prints "234" (without the "s, ending in newline)

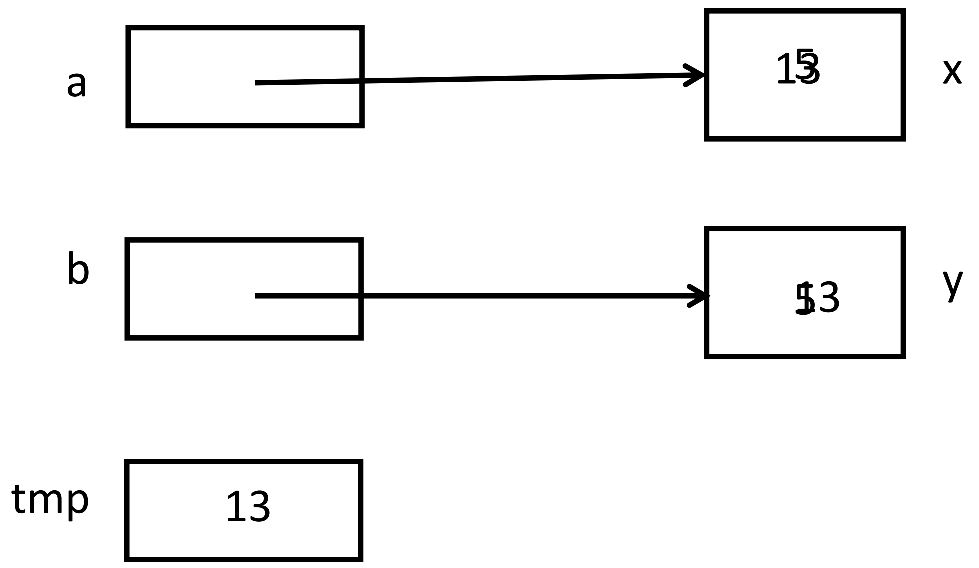
Function Arguments (No Pointers)

```
void swap(int a, int b)
{
        int tmp;

        tmp = a;
        a = b;
        b = tmp;
}
```



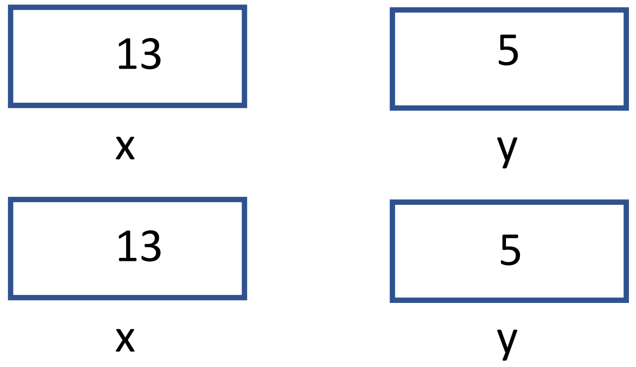
Function Arguments (Pointers)

```
void swap(int *a, int *b)
{
       int tmp;

       tmp = *a;
       *a = *b;
       *b = tmp;
}
```



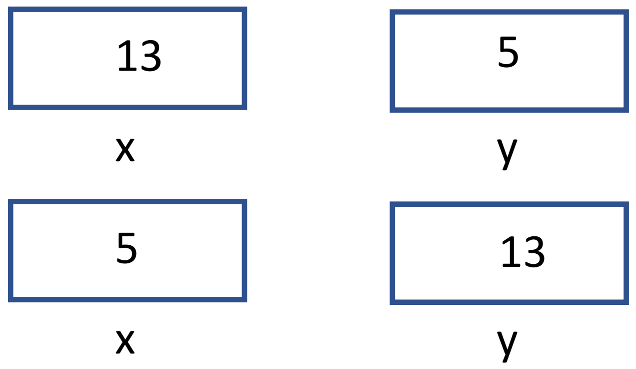
And On The Calling End (No Pointers)

```
x = 13;
y = 5;
printf("x = %d, y = %d\n", x, y);
swap(x, y);
printf("x = %d, y = %d\n", x, y);
```



And On The Calling End (With Pointers)

```
x = 13;
y = 5;
printf("x = %d, y = %d\n", x, y);
swap(&x, &y);
printf("x = %d, y = %d\n", x, y);
```



Scope

- When multiple variables have the same name, which one is used?
  - Rule #1: two variables cannot have the same name in a block (e.g., function)
- Use the variable that is “nearest” to the reference
  - That’s the one in scope