

CS50 Week 4

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Today's Agenda

Pointers

Memory Management



Input/Output (I/O)

Redirection

File I/O

Pointers (1)

`int x = 80`

`0x77AF`

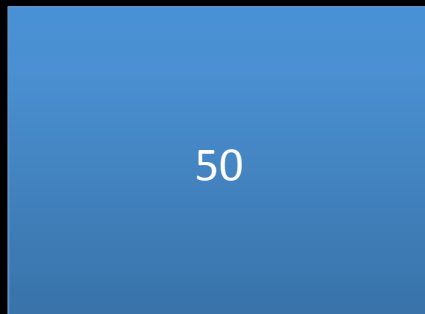
`address + value`

Pointers (2)

A pointers value *is* an address.

```
int x = 50;
```

```
int* ptr = &x;
```



0x123

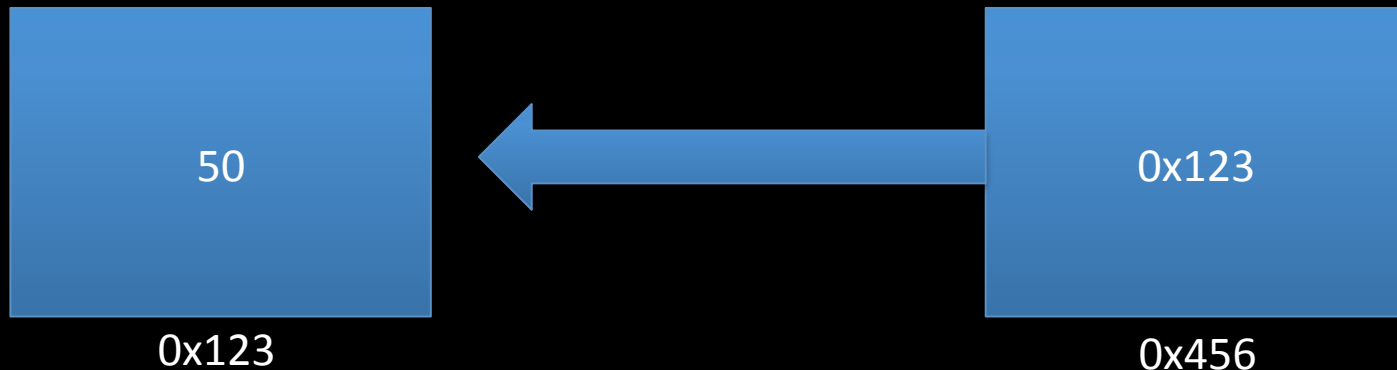


0x456

Pointers (2)

A pointers value *is* an address.

```
int x = 50;          int* ptr = &x;
```



Pointers (3)

```
// declare a pointer
```

```
int* ptr;
```

```
// get an address and store it in a pointer
```

```
int x = 50;
```

```
ptr = &x;
```

```
// go to the address and print its value
```

```
printf("%d\n", *ptr)
```

Pointer Syntax

- * operator gets a value from an address
- & operator gets an address for a value

Pointer Practice

Sketch on paper:

```
int x = 2, y = 8, z = 12
```

```
int* ptr_x = &x;
```

```
int* ptr_y = &y;
```

```
int* ptr_z = &z;
```

```
z = x*y;
```

```
x *= y;
```

```
y = *ptr_x;
```

```
*ptr_x = x * y;
```

```
ptr_x = ptr_y
```

```
x = (*ptr_y) * (*ptr_z)
```


Memory Management

Heap vs Stack

Stack: metadata, read-only variables, *all locals*

Heap: memory allocated dynamically.

`malloc ()`

malloc() example

```
int* ptr = malloc(sizeof(int));
```

```
int* ptr = malloc(10*sizeof(int));
```

What's the difference?

Remember to always free()

Input/Output (I/O)

Input is Input, Output is Output

Examples of input: command line arguments,
GetString()

Examples of output: printed pyramid, game of
fifteen.

Redirection

So far, we've usually had to type all of our input.

All of our output went to the terminal
immediately.

What if this isn't convenient?

Command Line I/O aka Redirection

Tools that are part of the OS:

>

>>

2>

<

|

Let's see some examples.

File I/O

What if we want to use files in our programs?

```
FILE* f = fopen(<fname>, <mode>)
```

modes: "w", "r", "rw", "a" among others

Like `malloc()`, remember to `fclose()`

File I/O

Functions to know & love:

`fopen()`, `fwrite()`,
`fread()`, `fgets()`,
`fputs()`, `fgetc()`,
`fputc()`, `fclose()`

Quiz next week!

I will do attempt to write a practice Quiz. I will email it to you and post it online if I do.