Pointers
Ch 9 & 13.1

Hey, don't I know you?

Don't you know that pointing is rude?

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Highlights

- pointers

```c
int x = 6;
int* xp;
xp = &x;
```
Review: address vs value

Consider the following:

```cpp
int x=6;
cout << x << "\n";
cout << &x << endl;
```

`x` is a variable (a box containing value 6)

`&x` is a memory address (sign pointing to box)
- Rather than giving the value inside the box, this gives the whole box
Review: address vs value

Similar to a URL and a webpage
-A URL is not a webpage, but a link to one

Webpage g;
cout << &g;
Pointers

Just as `&` goes from value (webpage) to address (url), `*` goes the opposite:

Webpage g;
URL u = &g;
Webpage g2 = *u;
Pointers

You can also think of pointers as “phone numbers” and what they point to as “people”

1-800-presdnt (pointer)

Obama (object)
Pointers

If multiple people have the same “phone number”, they call the same person (object)

1-800-presdnt (pointer/memory address)

Obama (object)

1-800-presdnt
Pointers

A pointer is used to store a memory address and denoted by a * (star!)

```cpp
int x = 6;
int* xp;
xp = &x;
```

Here variable xp is an integer pointer

```cpp
cout << *(&x); // *(&x) same as x
```

The * goes from address to variable (much like when you hit ENTER on a url)

(See: pointerBasics.cpp)
Pointers

It is useful to think of pointers as types:

```c
int* xp;
```

Here I declared a variable “xp” of type “int*”

Just like arrays and [], the use of the * is different for the declaration than elsewhere:

Declaration: the * is part of the type (int* xp;)

Everywhere else: * follows the pointer/address (i.e. *xp = 2; puts 2 where xp is pointing to)
Pointers

Pointers and references allow you to change anything into a memory address that you want.

This can make it easier to share variables across functions.

You can also return a pointer from a function (return links to variables) (see: returnPointer.cpp)
Pointers

Why do we need pointers? (memory addresses are stupid!!!)

Suppose we had the following class:

```cpp
class Person{
    string name;
    Person mother;
    Person father;
};
```

Will this work?
Pointers

As is, it will not... it is impossible to make a box enclose two other equal sized boxes.

The only way it can enclose something like itself is that thing is smaller.
Pointers

To do this we can use pointers instead!

A pointer does not store the whole class data, it only remembers where it is (like a URL)

```cpp
class person{
    string name;
    person* mother;
    person* father;
};
```

(See: person.cpp) (more on this shortly)
When dealing with classes, often you need to deference (*) and access a member (.)

There is a shortcut to de-reference and call a member (follow arrow and go inside a box)

You can replace (*var).x with var->x, so...

```cpp
(*(me.mother)).name;
```

... same as ...

```cpp
me.mother->name;
```
Person class

How would you make your grandmother? How could you get your grandmother using only yourself as a named object?

class person{
    string name;
    person* mother;
    person* father;
};

(See: personV2.cpp)