Late binding
April 22, Ch 15.3
Highlights

- Late binding for functions

```cpp
class Person{
public:
    virtual void swing();
};

class Boxer : public Person
{
public:
    void swing();
};
```
Review: Storing types

Last time we discussed how to properly store a Child object inside a Parent (using pointer)

```
Parent* x = new Child;
```

If we did not use a pointer, it would not work:

```
Parent x = Child;
```

This will only copy the Parent's part of a Child into itself (then delete child)
Early vs late binding

**Static binding** (or early) is when the computer determines what to do when you hit the compile button.

**Dynamic binding** (late) is when the computer figures out the most appropriate action when it is actually running the program.

Much of what we have done in the later parts of class is similar to late binding.
Static/dynamic binding is similar to how we originally made arrays: (static/early binding)

```c++
// need to know the size when compiling
int x[20];
```

To dynamic memory arrays: (dynamic/late)

```c++
cin >> size;
// may not know how big x is until this line
int* x = new int[size];
```
Dynamic binding

Consider this relationship:
Dynamic binding

Tell each of them to swing()!
Dynamic function binding

Who's swing function is being run?

```java
Person p = Person();
Boxer b = Boxer();
p = b;
p.swing();
```
Dynamic function binding

Who's swing function is being run?

```java
Person p = Person();
Boxer b = Boxer();
p = b;
p.swing();
```

Answer: the Person's

If you have normal variables, p=b only copies b's Person parts into p's Person box, so you still only have one swing function
Dynamic function binding

Who's swing function is being run now?

```c++
Person* p = new Person();
Boxer* b = new Boxer();
p = b;
p->swing();
```
Dynamic function binding

Who's swing function is being run now?

```cpp
Person* p = new Person();
Boxer* b = new Boxer();
p = b;
p->swing();
```

Answer: the Person's still...

p is pointing to a full Boxer object, but it only thinks there is the Person part due to type (see: incorrectChildFunction.cpp)
If we want the computer to not simply look at the “type” of pointer and instead determine what action to take based on the object...

... we need to add virtual (this is slower)

class Person{
  public:
    virtual void swing();
};

(see: dynamicBindingFunction.cpp)
Dynamic function binding

If you use a function to run an object and you want to use virtualization, you need to pass-by-reference (i.e. use an &)

If you do not, it will make a copy and this will ignore the Child's part

Always a Person

Can be Person, Boxer or Baseballer

```c
void doSwing(Person p) {
    p.swing();
}
```

```c
void doSwing(Person& p) {
    p.swing();
}
```
If you want to use this virtualization:
1. Pass in a pointer
2. Pass by reference (i.e. use &)

Needs to be memory address so the computer can look at what type is actually there

If you give it a Parent box, it cannot do anything but run normal Parent stuff (see: dynamicBindingFunctionV2.cpp)
virtual deconstructors

If you use Parent* to dynamically create a instance of a Child class, by default it will ONLY run the parent's deconstructor

With a virtual deconstructor it will run the deconstructor for whatever it is pointing at (the Child's deconstructor in this case)

Thus it avoids memory leak (see: yetAnotherMemoryLeak.cpp)

```cpp
class Parent { 
public:
    virtual ~Parent();
};
```