Class inheritance: is-a

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General case, special case

You can have classes where an object of one class is a special case of the other class. You declare that as

```
class General {
protected: // note!
 int g;
public:
 void general_method() {};
};

class Special : public General {
public:
  void special_method() { g = ... };
};

int main() {
  Special special_object;
  special_object.general_method();
  special_object.special_method();
}
```

Inheritance: derived classes

Derived class `Special` *inherits* methods and data from *base class* `General`:

```
int main() {
  Special special_object;
  special_object.general_method();
```

Members and methods need to be `protected`, not `private`, to be inheritable.

Constructors

When you run the special case constructor, usually the general case needs to run too. By default the 'default constructor', but:

```
class General {
public:
  General( double x,double y ) {};
};
class Special : public General {
public:
  Special( double x ) : General(x,x+1) {};
};
```

Access levels

Methods and data can be

- private, because they are only used internally;
- public, because they should be usable from outside a class object, for instance in the main program;
- protected, because they should be usable in derived classes (see section **??**).

Exercise 1

Take your code where a `Rectangle` was defined from one point, width, and height.

Make a class `Square` that inherits from `Rectangle`. It should have the function `area` defined, inherited from `Rectangle`.

First ask yourself: what should the constructor of a `Square` look like?

Exercise 2

Revisit the `LinearFunction` class. Add methods `slope` and `intercept`.

Now generalize `LinearFunction` to `StraightLine` class. These two are almost the same except for vertical lines. The `slope` and `intercept` do not apply to vertical lines, so design `StraightLine` so that it stores the defining points internally. Let `LinearFunction` inherit.

Overriding methods

- A derived class can inherit a method from the base class.
- A derived class can define a method that the base class does not have.
- A derived class can *override* a base class method:

```
class Base {
public:
  virtual f() { ... };
};
class Deriv : public Base {
public:
  virtual f() override { ... };
};
```

More

- Multiple inheritance: an X is-a A, but also is-a B.
  This mechanism is somewhat dangerous.
- Virtual base class: you don't actually define a function in the base class, you only say 'any derived class has to define this function'.
- Friend classes:

```
class A;
class B {
  friend class A;
private:
  int i;
};
class  A {
public:
  void f(B b) { b.i; };
};
```

  A `friend` class can access private data and methods even if there is no inheritance relationship.