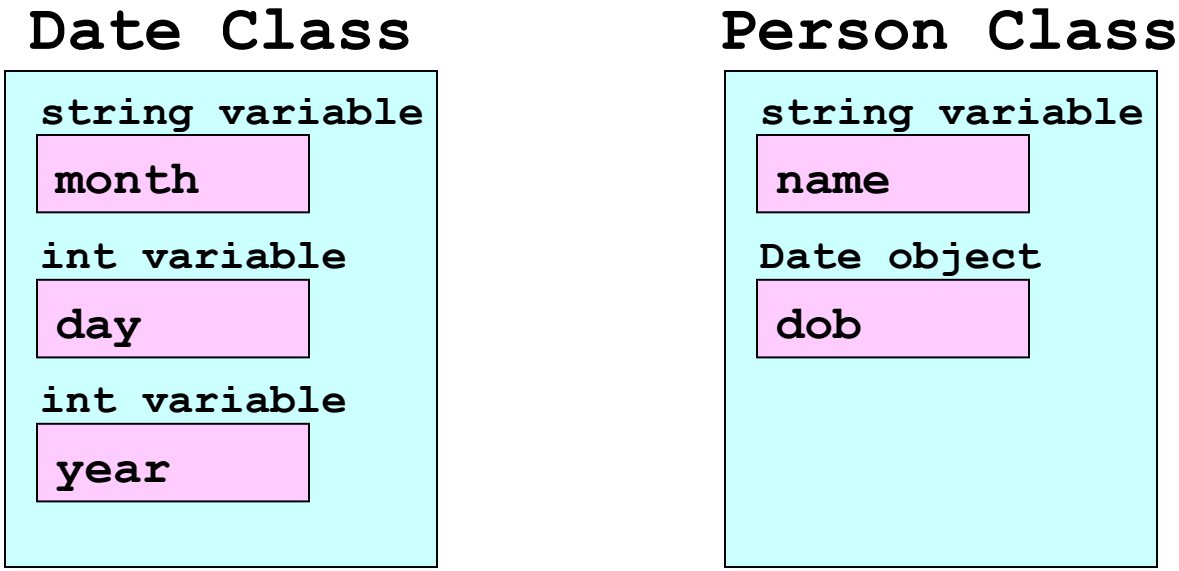
Object Composition

- This is when one object is a member variable of another class
- This relationship is called a *has-a* relationship

Example



- Person class *has-a* Date object
- Let's look at the code that implements the above

Date Class

```
class Date
{
private:
    string month;
    int day;
    int year;
public:
    Date(string month, int day, int year)
    { setDate(month, day, year); }
    Date(){ setDate("January", 1, 1900); }
    void setDate(string month, int day, int year)
    {this->month = month; this->day = day; this->year = year;}
    string getMonth() { return month; }
    int getDay() { return day; }
    int getYear() { return year; }
};
```

Person Class

```
class Person
{
private:
   string name;
   Date dob;     // has-a Date object (Composition)
public:
   Person(string name, string month, int day, int year)
   { this->name = name; dob.setDate(month, day, year); }
   void print()
   { cout << name << "\'s birthday is on "
          << dob.getMonth() << "  " << dob.getDay()
          << ", " << dob.getYear();
   }
};
```

Main Function

```
Person buddy("Bill Stump",
                    "February", 5, 1975);


buddy.print();
```

Inheritance

- Classes that use inheritance are said to have an *is-a* relationship

- Examples:
  - Person *has-a* Date
  - Student *is-a* Person
  - Faculty *is-a* Person

Protected Data Members and Functions

- Until now, we've been working with two access specifications:
  - private
  - public
- Another access specification is:
  - protected

Protected

- Recall from the example last time, that Person class contained one private data member
  - `string name;`
- This meant that functions in the class Student (that is derived from Person) could not directly access Person's private data members
  - `Student(string aName) { name = aName; }`

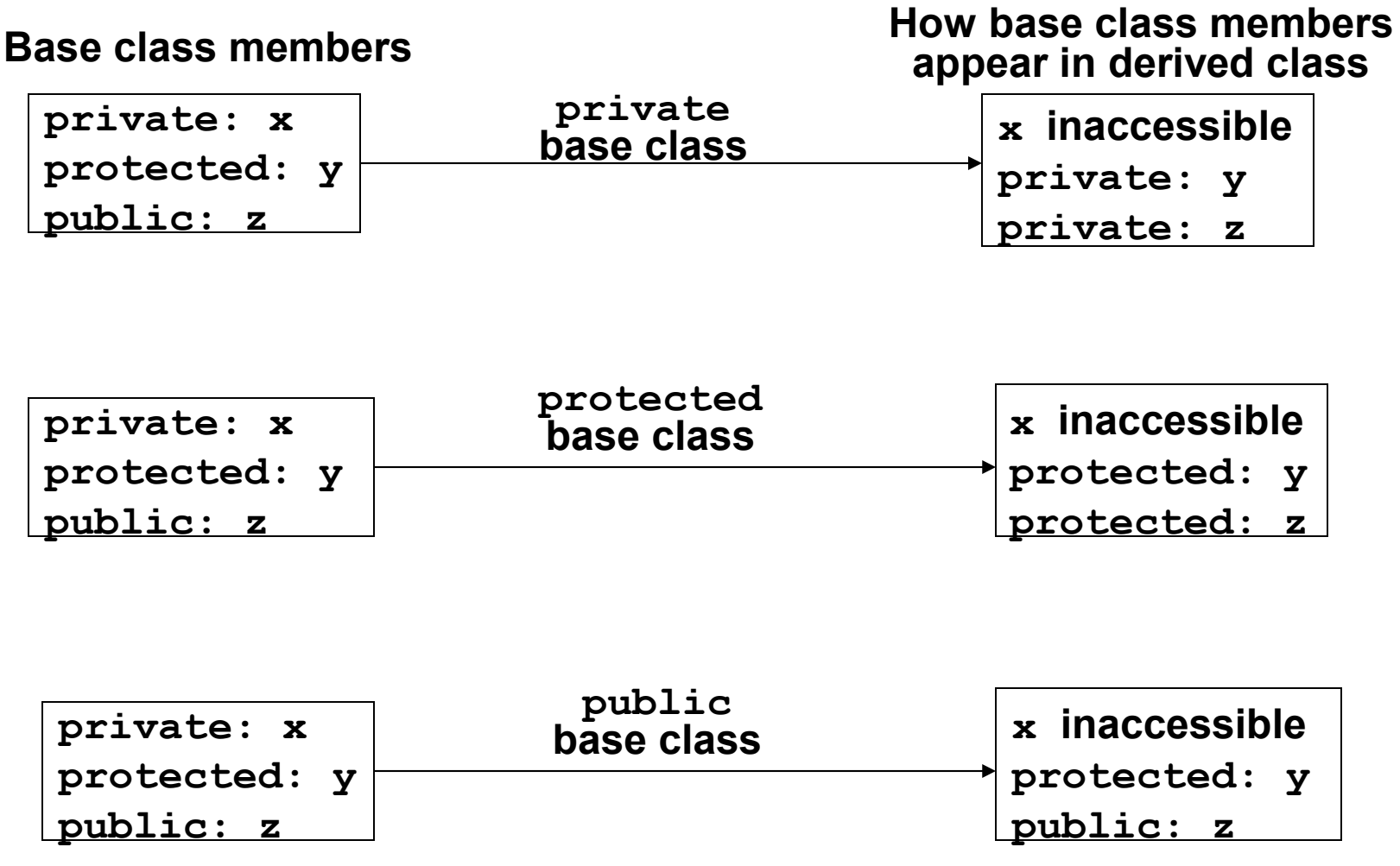
Protected

- Protected members of a class are just like private members, except that derived classes may access them directly

Base Access Specifications

- Recall that Student was publicly derived from Person
  - `class Student : public Person`
- This is called the base access specification
- We could also use private or protected
  - `class Student : public Person`
  - `class Student : protected Person`
  - `class Student : private Person`

Base Access Specifiers



Constructors

- When creating an object of a derived class, which constructor is called first?
  - The base class first
  - Then the derived class
- When destroying an object of a derived class, which destructor is called first
  - The derived class first
  - Then the base class