Member Functions

Class

- A class describes a set of objects with the same behavior
- Variables of a class are called objects

- Every class has:
  - Data members
  - Member functions

Example

We have used the string class, but we didn’t have to deal with how str.substr(6) works, or what str[6] is actually doing.

- We had access to the **public interface** to the string class, and just got to use that
- Protects the class from us accidentally messing it up

A generic class interface

```
class NameOfClass
{
  public:
    // the public interface

  private:
    // the data members
};
```

Use CamelCase for the names of classes

Any part of our program should be able to call the member functions.
→ they go in the public interface

Data members are defined in the *private section* of the class. Only member functions (within our class) can access the data members. They're hidden from the rest of the program
→ they go in the private section of the class

Designing a class: pokemon

```
class Pokemon
{
public:
    // function prototypes
private:
    string _name;
    int _HP;
};
```

Member Functions

Two types:

1. Mutators / setters
2. Accessors / getters

Designing a class: pokemon

```
class Pokemon
{
public:
    void setName(string n);
    void setHP(int h);
    string getName() const;
    int getHP() const;
private:
    string _name;
    int _HP;
};
```

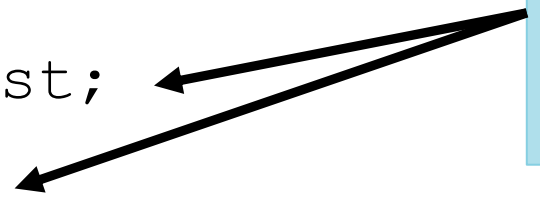
These are function prototypes.
We'll define them later.

What is const?

```
class Pokemon
{
public:
    void setName(string n);
    void setHP(int h);
    string getName() const;
    int getHP() const;
private:
    string _name;
    int _HP;
};
```

What is const?

```
class Pokemon
{
public:
    void setName(string n);
    void setHP(int h);
    string getName() const;
    int getHP() const;
private:
    string _name;
    int _HP;
};
```



getters only report the values of data members, and never alter them
→ we declare these functions to be const so they can't mess our stuff up

Dot Notation

You call the member functions by first creating a variable of type **Pokemon** and then using the dot notation:

```
Pokemon pikachu;
...
pikachu.setName(“pikachu”);
pikachu.setHP(80);
...
int health = pikachu.getHP();
cout << “Pikachu hp: ” << health << endl;
```

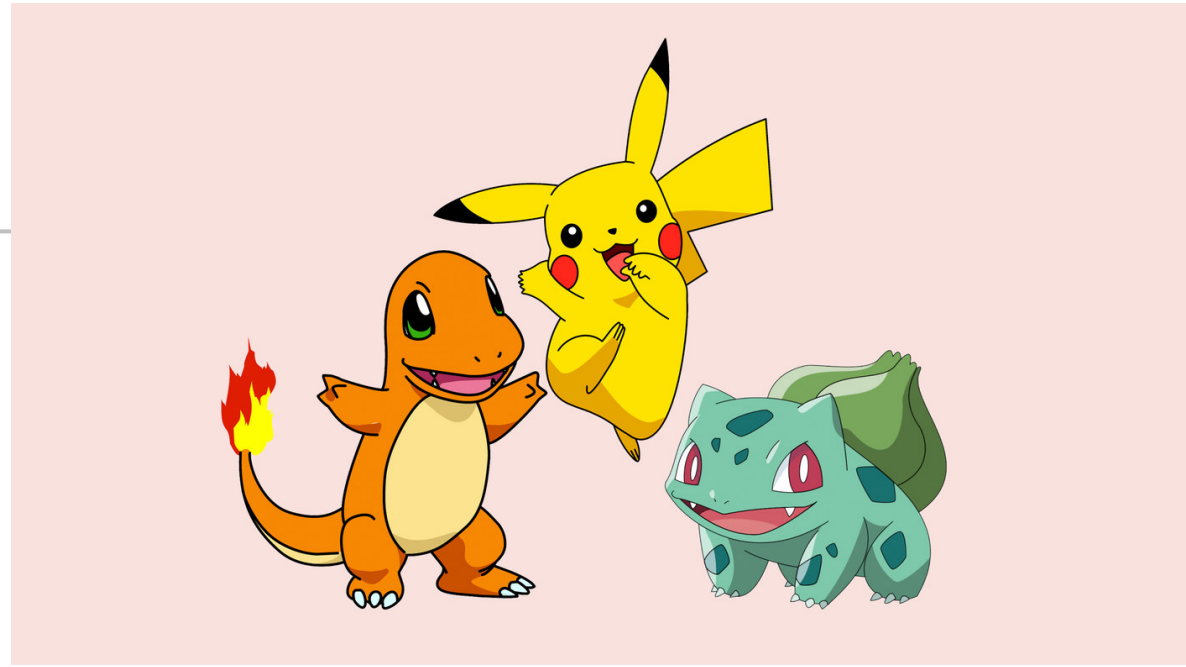
Encapsulation

- We might want to change how data members are computed and/or manipulated, but the important details (data members) shouldn't necessarily change.
- Example:
  - We can write the mutator for `_HP` so it can never be negative
  - On the other hand, if `_HP` were public, we could just straight up set it to be negative.

Encapsulation

Every `Pokemon` object has its own copy of these data members

```
Pokemon pikachu;
Pokemon charmander;
… [use setter functions] ...
```



pikachu

```
_name = pikachu
_HP = 100
```

charmander

```
_name = charmander
_HP = 70
```

…. …..

Encapsulation

The private data members are only accessible via member functions:

- Won't work: `Pokemon pikachu;`

```
… [use setter functions] ...
cout << pikachu._name << endl;
```

Encapsulation

The private data members are only accessible via member functions:

- Won't work:
```
Pokemon pikachu;
… [use setter functions] ...
cout << pikachu._name << endl;
```
- Will work!
```
Pokemon pikachu;
… [use setter functions] ...
cout << pikachu.getName() << endl;
```

Encapsulation

- You can move data members to the public interface and make it accessible
- DON’T! It is not good practice
  - Will keep things tidier and easy to debug!

The Interface

- The interface should not change even if the details of how they are implemented change.
- A driver switching to an electric car does not need to re-learn how to drive.

Class Implementation

Class Implementation

```
class Pokemon
{
public:
    void setName(string n);
    void setHP(int h);
    string getName() const;
    int getHP() const;
private:
    string _name;
    int _HP;
};
```

Now that we have the interface, we need to actually define the prototypes!
→ start by **implementing the member functions**

Implementing member functions

- Start with the setName() member function:

```
void setName( string name ) {
      _name = name;
}
```

- One more thing to add: as written, there is no connection to the Pokemon class!

Implementing member functions

- Start with the setName() member function:

```
void setName( string name ) {
      _name = name;
}
```

- One more thing to add: as written, there is no connection to the Pokemon class!
- so we specify for our member functions:

```
Pokemon::[member function name]
```

Implementing member functions

- We do not need the Pokemon:: declaration when defining the class:

```
class Pokemon {
      public:
      ...
      void setName( string name );
      …
      private:
      ...
};                                    // no need to add ;
void Pokemon::setName( string name )  // we are defining the function here
{
      _name = name;
}
```

Implicit Parameters

Implicit Parameters

- When we call `setHP( 20 )`, how does it know which `Pokemon's _HP` to update?

```
Pokemon pikachu, charmander;
 … [stuff happens] …
pikachu.setHP( 20 );

void Pokemon::setHP( int HP ) {
     _HP = HP;
}
```

Implicit Parameters

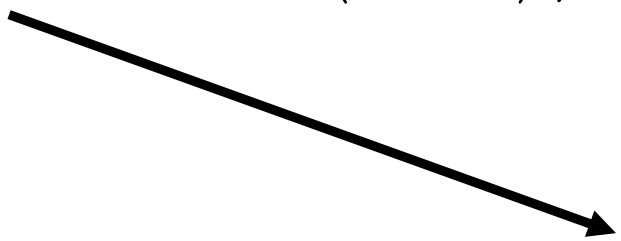
- When we call `setHP( 20 )`, how does it know which `Pokemon's _HP` to update?

```
Pokemon pikachu, charmander;
 … [stuff happens] …
pikachu.setHP( 20 );
```

`pikachu` → pass as an implicit parameter into the `setHP()` function

Implicit Parameters

```
Pokemon pikachu, charmander;
 … [stuff happens] …
pikachu.setHP( 20 );
```

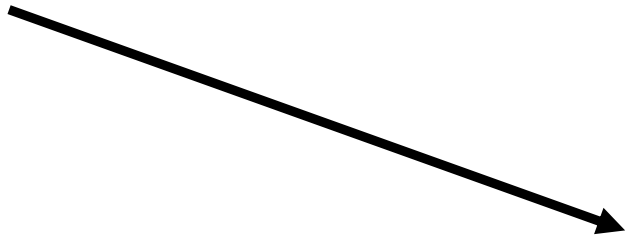


```
void Pokemon::setHP( Pokemon pikachu, int HP ) {
        _HP = HP;
}
```

Implicit Parameters

pikachu.setHP(20) knows to set hp value to 20 for ***pikachu*** the same way str1.length() knows to take the length of ***str1***

```
Pokemon pikachu, charmander;
 … [stuff happens] …
pikachu.setHP( 20 );
```



```
void Pokemon::setHP( int HP ) {
```

```
    pikachu._HP = HP;
}
```

Constructors

Constructors

- A constructor is a member function that initializes the data members of an object.
- The constructor is automatically called whenever an object is created.

```
Pokemon pikachu;
```

- (You don’t see the function call nor the definition in the class, it but it’s there.)

Motivation

- By supplying a constructor, by writing our own implementation, you can ensure that all data members are properly set before any member functions act on an object.
- To understand the importance of constructors, consider:

```
Pokemon pikachu;
pikachu.setName("pikachu");
int health = pikachu.getHP(); // May not be 1
```

- Notice that the programmer forgot to call **set initial values** before calling getters.

Constructor Code

- You declare constructor functions in the class definition. There must be **no** return type, not even **void**.
- The name of the constructor must be the same as the class:

```
class Pokemon
{
public:
   Pokemon(); // A constructor
...
};
```

- The constructor definition resembles other member functions:

```
Pokemon:: Pokemon()
{
   _HP = 100;
   _name = " ";
}
```

Default Constructors

- If you do not write a constructor for your class, the compiler automatically generates one for you, which does nothing but allocate memory space for the data members.

- The compiler does NOT provide safe initial data values, EXCEPT that `string` members are initialized to “”.

- Default constructors are called when you define an object and do not specify any parameters for the construction.

```
Pokemon pikachu;
```

Parameterized Constructors

- Constructors can have parameters, and can be overloaded :

```
class Pokemon
{
public:
  // “Default” constructor: Sets hp & evolution = 0
  Pokemon();
  // Sets _name = n, _HP = HP
  Pokemon(string n, int HP);
private:
  int _HP
  string _name;
};
```

Overloaded Constructors

- When the same name is used for more than one function, then the functions are called **overloaded**. The compiler determines which to use, based on the parameter list of the call.
- When you construct an object, the compiler chooses the constructor that matches the parameters that you supply:

```
Pokemon(); // Uses default constructor

Pokemon(“pikachu”, 100); // uses
        parameterized constructor
```

Common Error: Resetting objects

- You cannot call a constructor with dot notation to “reset” an object.

```
Pokemon pikachu;
...
pikachu.Pokemon(); // Syntax Error
```

- The correct way to reset an object is to construct a new one and assign it to the old:

```
pikachu = Pokemon(); //creates an
// unnamed object, then copies it to pikachu
```