CSc 110, Autumn 2016

Lecture 31: Encapsulation

Adapted from slides by Marty Stepp and Stuart Reges

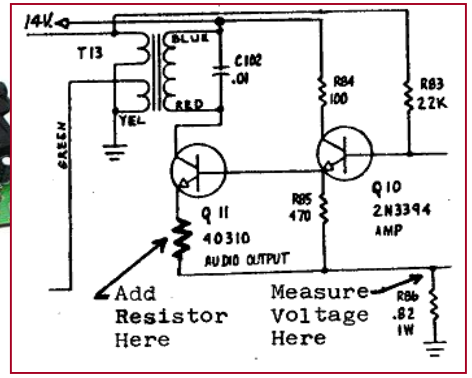
Abstraction

Don't need to know this

Can focus on this!!

Encapsulation

- **encapsulation**: Hiding implementation details of an object from its clients.
  - Encapsulation provides *abstraction*.
    - separates external view (behavior) from internal view (state)
  - Encapsulation protects the integrity of an object's data.



Private fields

- A field can be made invisible to outsiders
  - No code outside the class can access or change it easily.

    __name

  - Examples:

```
self.__id
self.__name
```

- Client code sees an error when accessing private fields:

Accessing private state

- We can provide methods to get and/or set a field's value:

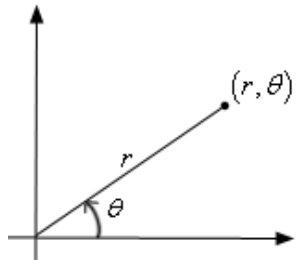
```
# A "read-only" access to the __x field ("accessor")
def get_x(self):
    return self.__x

# Allows clients to change the __x field ("mutator")
def set_x(self, new_x):
    self.__x = new_x
```

  - Client code will look more like this:

```
print("p1: (" + str(p1.get_x()) + ", " + str(p1.get_y()) + ")")
p1.set_x(14)
```

Benefits of encapsulation

- Provides abstraction between an object and its clients.
- Protects an object from unwanted access by clients.
  - A bank app forbids a client to change an `Account`'s balance.
- Allows you to change the class implementation.
  - `Point` could be rewritten to use polar coordinates (radius *r*, angle ϑ), but with the same methods.



- Allows you to constrain objects' state (**invariants**).
  - Example: Only allow `Points` with non-negative coordinates.

Point class, version 4

```
# A Point object represents an (x, y) location.
class Point:
    self.__x
    self.__y

    def __init__(self, initial_x, initial_y):
        self.__x = initial_x
        self.__y = initial_y

    def distance_from_origin(self):
        return sqrt(self.__x * self.__x + self.__y * self.__y)

    def get_x(self):
        return self.__x

    def get_y(self):
        return self.__y

    def set_location(self, new_x, new_y):
        self.__x = new_x
        self.__y = new_y

    def translate(self, dx, dy):
        self.__x = self.__x + dx
        self.__y = self.__y + dy
```

Client code, version 4

```
def main9):
    # create two Point objects
    p1 = Point(5, 2)
    p2 = Point(4, 3)

    # print each point
    print("p1: (" + str(p1.get_x()) + ", " + str(p1.get_y()) + ")")
    print("p2: (" + str(p2.get_x()) + ", " + str(p2.get_y()) + ")")

    # move p2 and then print it again
    p2.translate(2, 4)
    print("p2: (" + str(p2.get_x()) + ", " + str(p2.get_y()) + ")")
```

OUTPUT:

```
p1 is (5, 2)
p2 is (4, 3)
p2 is (6, 7)
```