

## Objectives

- Defining our own classes

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## Review: Dictionaries

- What is a dictionary in Python?
- What is the syntax for creating a new dictionary?
- How do we access a key's value from a dictionary?
  - What happens if there is no mapping for that key?
- How do we create a key → value mapping in a dictionary?
- How can we iterate through a dictionary?

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# ABSTRACTIONS

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## Abstractions

- Provide ways to think about program and its data
  - Get the jist without the details
- Examples we've seen
  - Functions and methods `encodeFile(filename, key)`
    - Used to perform some operation but we don't need to know how they're implemented
  - Dictionaries
    - Know they map keys to values
    - Don't need to know how the keys are organized/stored in the computer's memory
  - Just about everything we do in this class...

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## Classes and Objects

- Provide an abstraction for how to organize and reason about data
- Example: GraphWin class
  - Had **attributes** (i.e., data or state) background color, width, height, and title
  - Each GraphWin object had these attributes
    - Each GraphWin object had its own values for these attributes
  - Used methods (API) to modify the object's state, get information about attributes

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## Defining Our Own Classes

- Often, we want to represent data or information that we do **not** have a way to represent using *built-in types* or *libraries*
- Classes provide way to *organize* and *manipulate* data
  - Organize: data structures used
    - E.g., ints, lists, dictionaries, other objects, etc.
  - Manipulate: methods

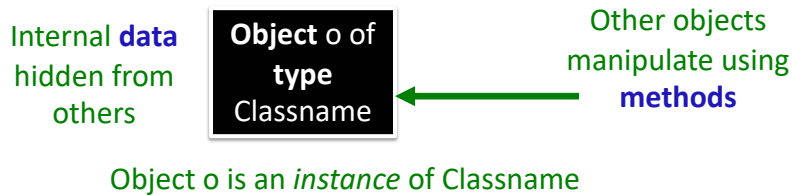
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## What is a Class?

- Defines a new **data type**
- Defines the class's **attributes** (i.e., data or state) and **methods**
  - Methods are like **functions** **within** a class and are the class's **API**



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## Defining a Card Class

- Create a class that represents a playing card
  - How can we represent a playing card?
  - What information do we need to represent a playing card?



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## Representing a Card object

- Every card has two attributes:
  - Suite (one of “hearts”, “diamonds”, “clubs”, “spades”)
  - Rank
    - 2-10: numbered cards
    - 11: Jack
    - 12: Queen
    - 13: King
    - 14: Ace

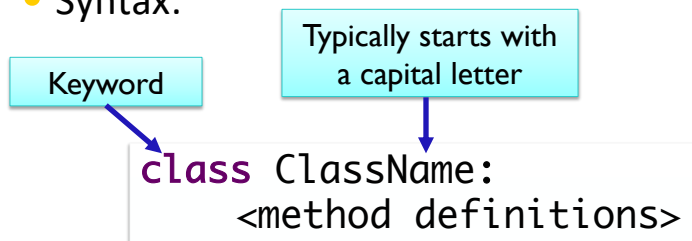
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## Defining a New Class

- Syntax:



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## Card Class (Incomplete)

Doc String

Methods

```
class Card:
    """ A class to represent a standard playing card.
        The ranks are ints: 2-10 for numbered cards, 11=Jack,
        12=Queen, 13=King, 14=Ace.
        The suits are strings: 'clubs', 'spades', 'hearts',
        'diamonds'."""
    def __init__(self, rank, suit):
        """Constructor for class Card takes int rank and
        string suit."""
        self._rank = rank
        self._suit = suit

    def getRank(self):
        "Returns the card's rank."
        return self._rank

    def getSuit(self):
        "Returns the card's suit."
        return self._suit
```

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## Card Class (Incomplete)

Doc String

Methods

```
class Card:
    """ A class to represent a standard playing card.
        The ranks are ints: 2-10 for numbered cards, 11=Jack,
        12=Queen, 13=King, 14=Ace.
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        'diamonds'."""
    def __init__(self, rank, suit):
        """Constructor for class Card takes int rank and
        string suit."""
        self._rank = rank
        self._suit = suit

    def getRank(self):
        "Returns the card's rank."
        return self._rank

    def getSuit(self):
        "Returns the card's suit."
        return self._suit
```

Methods are like *functions* defined in a *class*

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## Defining the Constructor

- `__init__` method is like the **constructor**
- In constructor, define **instance variables**
  - **Data** contained in every object
  - Also called **attributes** or **fields** Convention: named with `_`
- Constructor **never returns** anything
  - First parameter of every method is **self**
    - pointer to the object that method acts on

```
def __init__(self, rank, suit):  
    """Constructor for class Card takes int rank  
    and string suit."""  
    self._rank = rank  
    self._suit = suit
```

Instance variables

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## Review

- How do we use the constructor for an object?

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## Using the Constructor

```
def __init__(self, rank, suit):
```

- As defined, constructor is called using **Card(<rank>, <suit>)**
  - Do not *pass* anything for the **self** parameter
  - Python *automatically* passes the **self** parameter for us

Object card  
of type Card

```
_rank = ?  
_suit = ?
```

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## Using the Constructor

```
def __init__(self,  
rank, suit):
```

- As defined, constructor is called using **Card(<rank>, <suit>)**
  - Do not *pass* anything for the **self** parameter
  - Python *automatically* passes the **self** parameter for us
- Example:
  - **card** = Card(2, "hearts")
  - Creates a 2 of Hearts card
  - Python passes **card** as **self** for us
  - **card** is an instance of the Card class

Object card  
of type Card

```
_rank = 2  
_suit = "hearts"
```

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## Review

- How do we call a method on an object?

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## Accessor Methods

- Need to be able to get information about the object

- Have **self** parameter
- Return data/information

```
def getRank(self):  
    "Returns the card's rank."  
    return self._rank
```

```
def getSuit(self):  
    "Returns the card's suit."  
    return self._suit
```

**card = Card(..., ...)**

- These methods will get called as **card.getRank()** and **card.getSuit()**
  - Python plugs **card** in for **self**

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## Another Special Method: `__str__`

- Returns a *string* that describes the object
- Whenever you **print** an object, Python checks if the object's `__str__` method is defined
  - Prints result of calling `__str__` method
- `str(<object>)` also calls `__str__` method

```
def __str__(self):  
    """Returns a string  
    describing the card as 'rank of  
    suit'."""  
    result = ""  
    if self._rank == 11:  
        result += "Jack"  
    elif self._rank == 12:  
        result += "Queen"  
    elif self._rank == 13:  
        result += "King"  
    elif self._rank == 14:  
        result += "Ace"  
    else:  
        result += str(self._rank)  
    result += " of " + self._suit  
    return result
```

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## Using the Card Class

Invokes the  
`__str__` method

```
def main():  
    c1 = Card(14, "spades")  
    print(c1)  
    c2 = Card(2, "hearts")  
    print(c2)
```

Displays:

Ace of spades  
2 of hearts

Object **c1** of  
type Card

`_rank = 14`  
`_suit = "spades"`

Object **c2** of  
type Card

`_rank = 2`  
`_suit = "hearts"`

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## Example: Card Color

- **Problem:** Add a method to the Card class called `getCardColor` that returns the card's suit's color ("red" or "black")
- **(Partial) procedure** for defining a method (similar to functions)
  - What is the input to the method?
  - What is the output from the method?
  - (Wait on defining the body of the method)
- How do we call the method?
- How can we test the method using `test.testEqual` function?
  - Provide some test cases

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`card2.py`

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## Example: Card Color

- **Problem:** Add a method to the Card class called `getCardColor` that returns the card's suit's color ("red" or "black")
- **Procedure** for defining a method (similar to functions)
  - What is the input to the method?
  - What is the output from the method?
  - What is the method signature/header?
  - What does the method do?

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## Example: Rummy Value

- **Problem:** Add a method to the Card class called `getRummyValue` that returns the value of the card in the game of Rummy
- **Procedure** for defining a method (similar to functions)
  - What is the input to the method?
  - What is the output from the method?
  - What is the method signature/header?
  - What does the method do?
- How do we call the method?
- How can we test the method?

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## Looking Ahead

- Prelab 9 for tomorrow
  - Engaged in the object-oriented reading
- Lab 9 due Friday
- Exam Friday
  - Discussion on Wednesday

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