## Objectives

- Defining our own classes

## 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 do we iterate through a dictionary?
- What is an exception?
  - How do we handle exceptions

## Review: Exception Handling

```
try:
    inFile = open(infileName, "r")
    # normally, would process file here.
    inFile.close()
except IOError as exc :
    print("Error reading \"" + infileName + "\".")
    # could be a variety of different problems,
    # so print out the exception
    print(exc)
    print(type(exc))
    sys.exit(1)
```

- Exceptions are *objects*
- We can get more information about the exception by printing them out

file_handle.py

## Review: What do these solutions do?

```
if key not in dictionary :
    dictionary[key] = 1
else:
    count = dictionary[key] + 1
    dictionary[key] = count
```

```
if key not in dictionary :
    dictionary[key] = 1
else:
    dictionary[key] += 1
```

## Review: Equivalent Solutions
## A Dictionary of Accumulators

```
if key not in dictionary :
   dictionary[key] = 1
else:
   count = dictionary[key] + 1
   dictionary[key] = count
```

```
if key not in dictionary :
   dictionary[key] = 1
else:
   dictionary[key] += 1
```

## ABSTRACTIONS

## 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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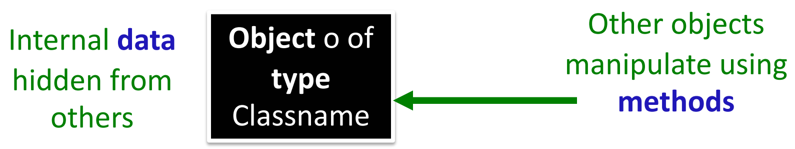
## Defining Our Own Classes

- 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

## 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**


Internal **data** hidden from others
**Object** o of **type** Classname
Other objects manipulate using **methods**

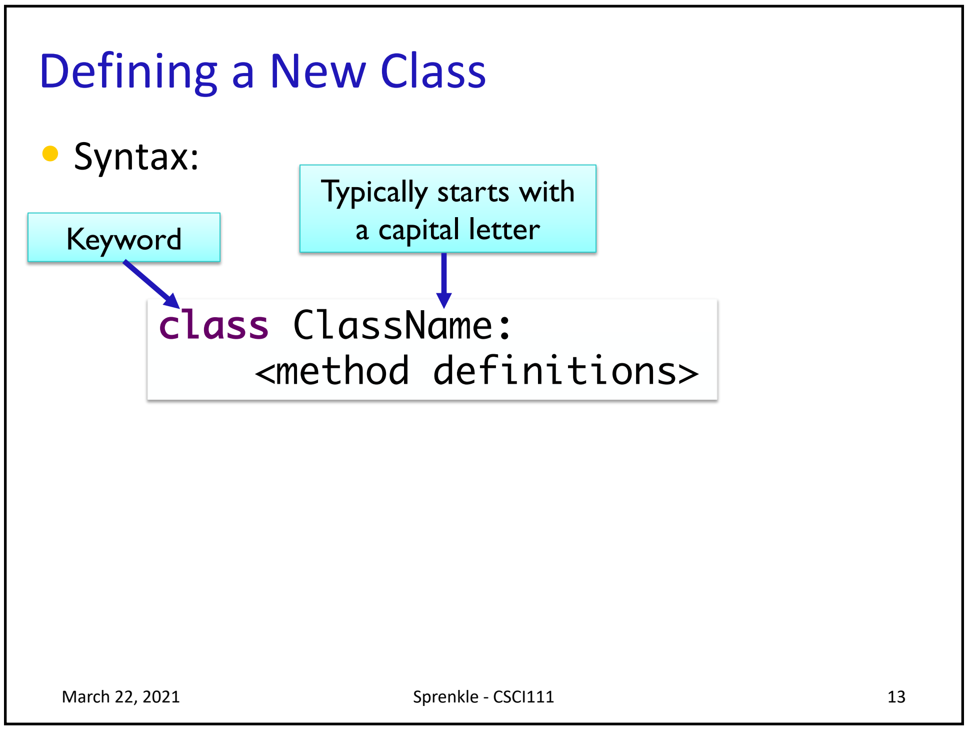
Object o is an *instance* of Classname

## 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?

## Representing a Card object

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



## Defining a New Class

- Syntax:

Keyword
Typically starts with a capital letter

```
class ClassName:
        <method definitions>
```

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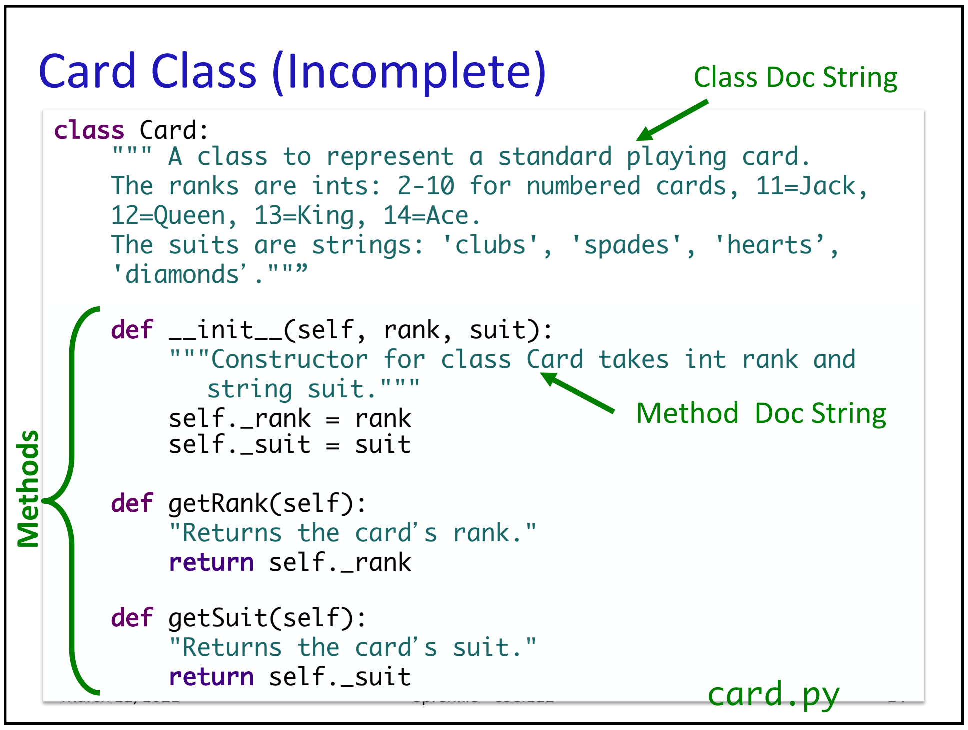

## Card Class (Incomplete)

Class Doc String
Method Doc String
Methods
card.py

```
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)

Class Doc String

```
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',
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    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
```

Method Doc String

Methods

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

card.py

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## Defining the Constructor: `__init__`

- `__init__` method is like the ***constructor***
- In constructor, define ***instance variables***
  - **Data** contained in every object
  - Also called **attributes** or **fields**
- Constructor **never *returns*** anything

**First parameter of *every* method is `self`**
- reference 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

Convention: named with _

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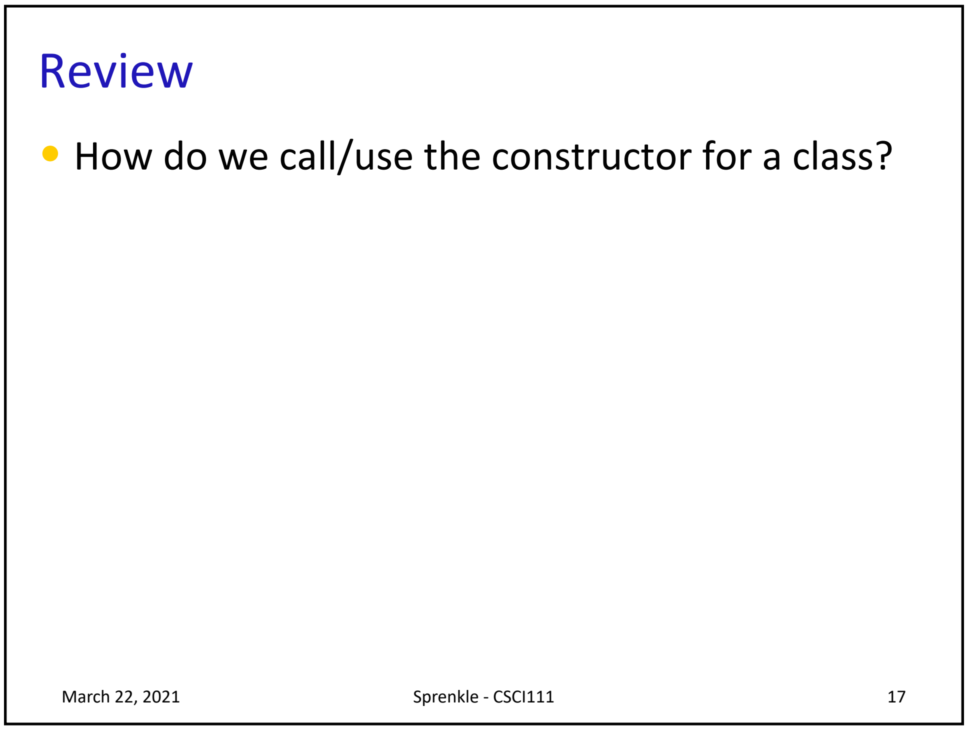

## Review

- How do we call/use the constructor for a class?

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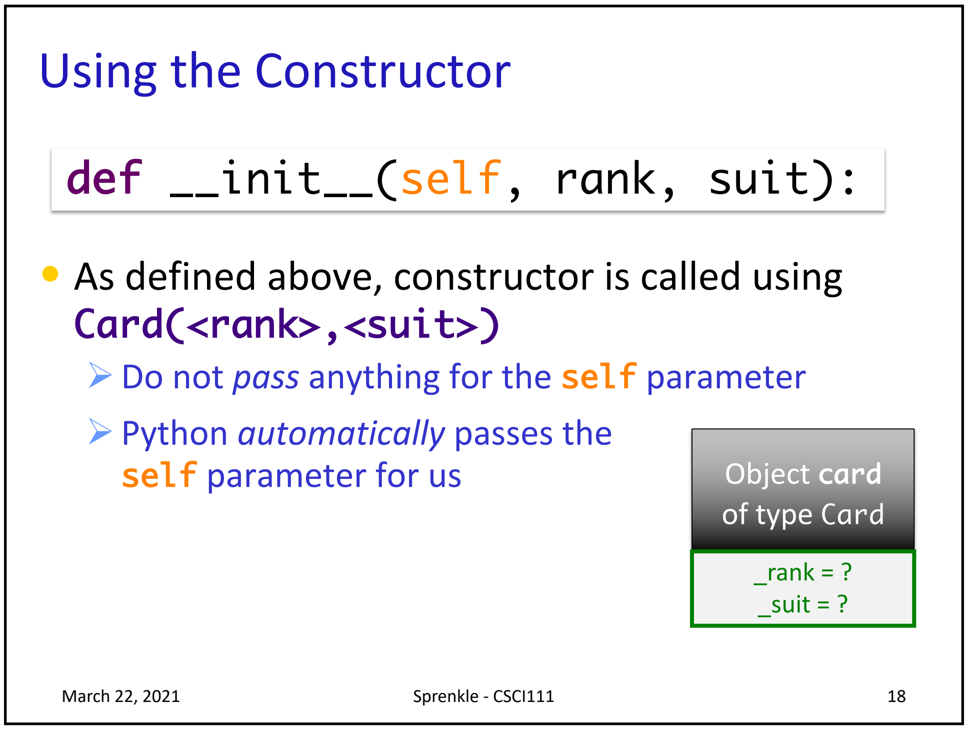
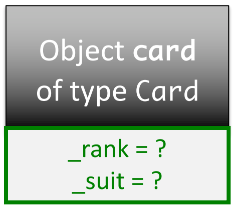


## Using the Constructor

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

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



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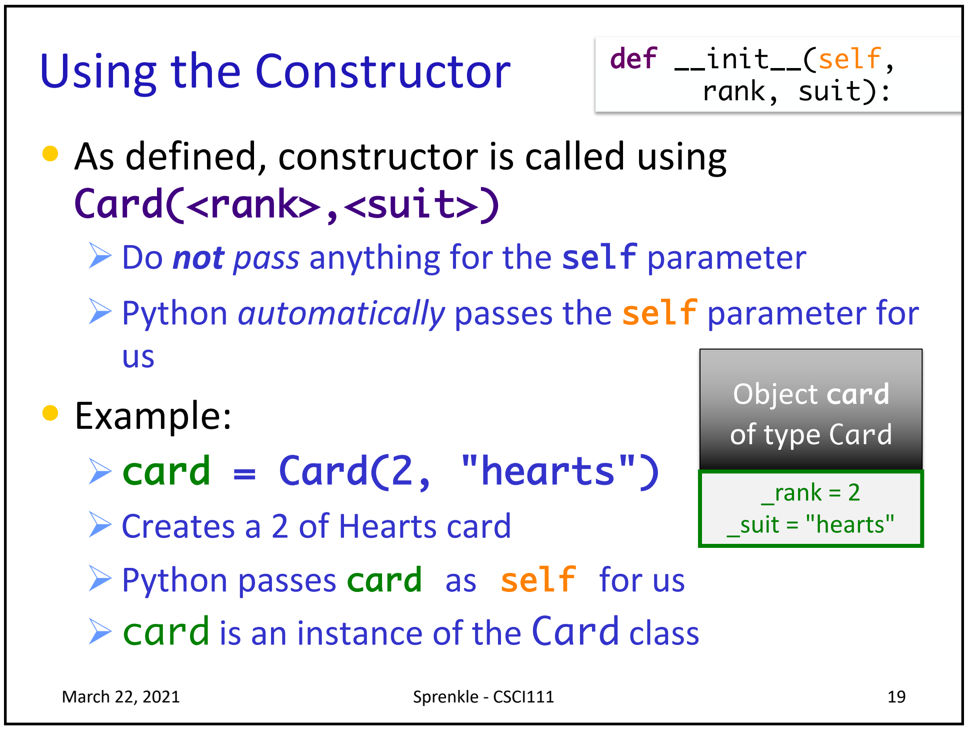

## Using the Constructor

```
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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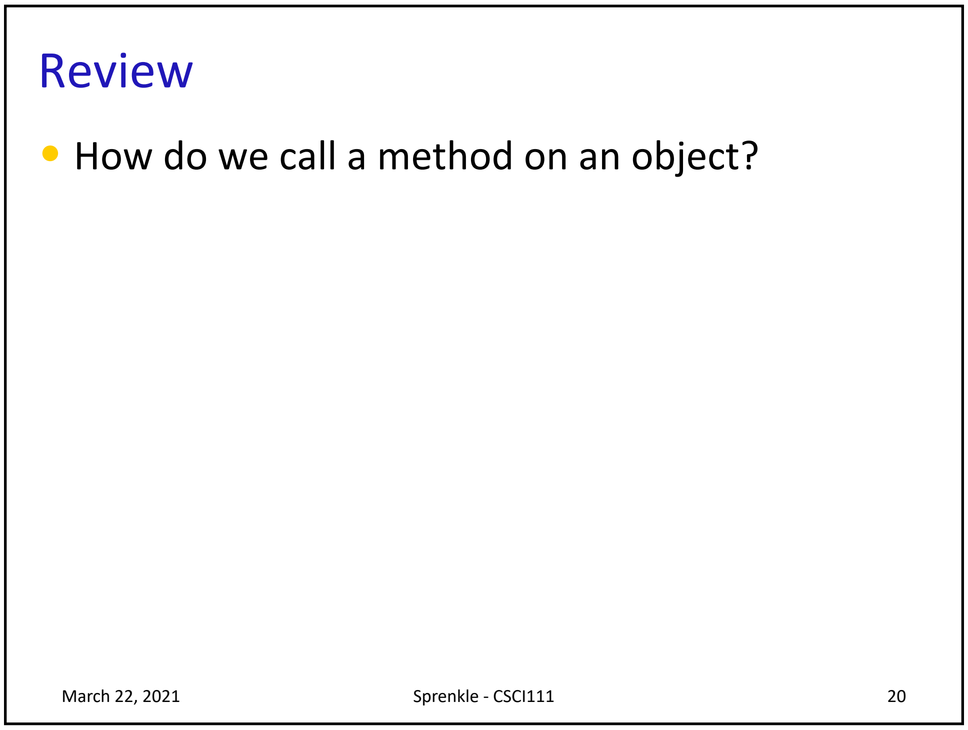

## Review

- How do we call a method on an object?

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## Accessor Methods

- To get information about the object

- Must take **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
```

- If previously created object using **card = Card(…, …)**, these methods would get called as **card.getRank()** and **card.getSuit()**
  - Python plugs **card** in for **self**

## 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
    representing 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
```

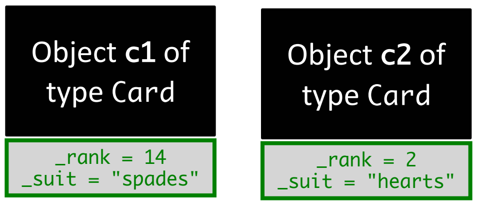
## Using the Card Class

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
```



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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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## 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
  - Engage in the object-oriented reading
- Lab 9 due Friday
- Exam Friday
  - Defining classes will not be on exam
  - Discussion on Wednesday