

# Object Oriented Programming

- `Object-oriented programming` is a programming methodology that provides a means of structuring programs so that properties and behaviors are encapsulated into `individual objects` .
- For instance, an object could represent a person with properties like a name, age, and address and behaviors such as walking, talking, breathing, and running. Or it could represent an email with properties like a recipient list, subject, and body and behaviors like adding attachments and sending.

## Define a Class in Python

- A class definition starts with the `class` keyword, which is followed by the name of the class and a colon.
- Any code that is indented below the class definition is considered part of the class's body.
- The attributes that objects must have are defined in a `__init__()` . It is called as `Constructor` of the class.
- Every time a new object is created, `__init__()` sets the initial state of the object by assigning the values of the object's properties.
- `__init__()` initializes each new instance of the class.
- Attributes created in `__init__()` are called **instance attributes**. An instance attribute's value is specific to a particular instance of the class.
- Instance attributes are always referred using `self` .
- `Instance methods` are functions that are defined inside a class and can only be called from an instance of that class.
- A `class attribute` is always defined outside the constructor and always referred using class name.

## Inheritance

- Inheritance allows us to define a class that inherits all the methods and properties from another class.
- Parent class is the class being inherited from, also called base class.
- Child class is the class that inherits from another class, also called derived class.

## Examples -

### Ex. Create class Circle

```
In [3]: class Circle :

    def __init__(self) :
        self.radius = 0

    def cal_area(self) :
        self.area = 3.14 * (self.radius ** 2)

c = Circle()
print(c)
print(c.radius)
c.radius = 10
# print(c.area) # Error
c.cal_area()
print(c.area)

<__main__.Circle object at 0x0000019C40148E90>
0
314.0
```

```
In [54]: class Circle :
    pi = 3.14 # Class variable

    def __init__(self, radius) : # Constructor
        self.radius = radius # instance variable / radius is local variable
        self.cal_area()

    def cal_area(self) : # Method - belongs to instance
        self.area = Circle.pi * (self.radius ** 2)

    @staticmethod
    def get_area(radius) :
        return Circle.pi * (radius ** 2)

c = Circle(10)
c.cal_area()
print(c.area)

314.0
```

```
In [42]: c1 = Circle(100)
c1.cal_area()
```

```
In [43]: c.area
```

```
Out[43]: 314.0
```

```
In [44]: c1.area
```

```
Out[44]: 31400.0
```

```
In [45]: Circle.pi
```

```
Out[45]: 3.14
```

```
In [46]: c1.pi # Class variable can be accessed by object instance
```

```
Out[46]: 3.14
```

```
In [47]: Circle.radius # instance variable cannot be accessed by class name
```

```
-----
AttributeError                                Traceback (most recent call last)
Cell In[47], line 1
----> 1 Circle.radius # instance variable cannot be accessed by class name

AttributeError: type object 'Circle' has no attribute 'radius'
```

```
In [48]: c1.get_area(10)
```

```
Out[48]: 314.0
```

```
In [50]: Circle.get_area(10)
```

```
Out[50]: 314.0
```

```
In [55]: class Circle :
          pi = 3.14 # Class variable

          def __init__(self, radius) : # Constructor
              self.radius = radius # instance variable | radius is local variable
              self.cal_area()

          def cal_area(self) : # Method - belongs to instance
              self.area = Circle.pi * (self.radius ** 2)
```

```
Out[55]: 314.0
```

```
In [ ] : # Define Circle instance by passing radius to it and use area variable to get area
```

```
In [56]: c = Circle(10)
          c.area
```

```
Out[56]: 314.0
```

```
In [ ]: # Define the Circle object by passing the radius and use cal_area method to get area
```

```
In [58]: class Circle :
        pi = 3.14 # Class variable

        def __init__(self, radius) : # Constructor
            self.__radius = radius # instance variable | radius is local variable

        def get_area(self) : # Method - belongs to instance
            return Circle.pi * (self.radius ** 2)
```

```
In [59]: c = Circle(10)
        c.get_area()
```

```
Out[59]: 314.0
```

```
In [141... print(dir(math))

['__doc__', '__loader__', '__name__', '__package__', '__spec__', 'acos', 'acosh', 'asin', 'asinh', 'atan', 'atan2', 'atanh', 'cbrt', 'ceil', 'comb', 'copysign', 'cos', 'cosh', 'degrees', 'dist', 'e', 'erf', 'erfc', 'exp', 'exp2', 'expm1', 'fabs', 'factorial', 'floor', 'fmod', 'frexp', 'fsum', 'gamma', 'gcd', 'hypot', 'inf', 'isclose', 'isfinite', 'isinf', 'isnan', 'isqrt', 'lcm', 'ldexp', 'lgamma', 'log', 'log10', 'log2', 'logp1', 'log2', 'modf', 'nan', 'nextafter', 'perm', 'pi', 'pow', 'prod', 'radians', 'remainder', 'sin', 'sinh', 'sqrt', 'sumprod', 'tan', 'tanh', 'tau', 'trunc', 'ulp']
```

```
In [142... print(dir(c))

['__class__', '__delattr__', '__dict__', '__dir__', '__doc__', '__eq__', '__format__', '__ge__', '__getattribute__', '__getstate__', '__gt__', '__hash__', '__init__', '__init_subclass__', '__le__', '__lt__', '__module__', '__ne__', '__new__', '__reduce__', '__reduce_ex__', '__repr__', '__setattr__', '__sizeof__', '__str__', '__subclasshook__', '__weakref__', 'area', 'cal_area']
```

**Ex. Create parent class Shape and Circle, Rectangle, Triangle as its child classes.**

**Ex. Define cal\_area() as abstract method in Shape class.**

**Ex. Override cal\_area() in all child classes of Shape class.**

**Ex. Define color\_cost() method in Shape class. Define \*\*kwargs in constructor of all child classes to set shape color at the time of object creation.**

```
In [102... from abc import ABC, abstractmethod
class Shape(ABC) :
    prices = {"red" : 10, "blue":20, "green" : 30, "white" : 1}

    def __init__(self) :
        self.cal_area()

    @abstractmethod
    def cal_area(self) :
        pass

    def get_cost(self, color = None) :
        price = Shape.prices.get(color, 1)
```

```

        cost = self.area * price
        return cost

class Circle(Shape) :
    pi = 3.14 # Class variable

    def __init__(self, radius) : # Constructor
        self.radius = radius # instance variable / radius is local variable
        super().__init__()

    def cal_area(self) : # Method - belongs to instance
        self.area = Circle.pi * (self.radius ** 2)

class Rectangle(Shape) :
    def __init__(self, length, breadth):
        self.length = length
        self.breadth = breadth
        super().__init__()

    def cal_area(self):
        self.area = self.length * self.breadth

```

```

In [106... c = Circle(10, color = "red")
           print(c.color)

```

red

```

In [100... r = Rectangle(10, 20)
           r.get_cost("red")

```

Out[100... 2000

```

In [96]: shapes_lst = [Circle(10), Rectangle(10, 20), Circle(100), Rectangle(100, 200)]

for shape in shapes_lst :
    shape.cal_area()
    print("Cost - ", shape.get_cost("red"))

```

```

Cost - 3140.0
Cost - 2000
Cost - 314000.0
Cost - 200000

```

```

In [ ]: shapes_lst = [Circle(10, "red"), Rectangle(10, 20, "green"), Circle(100, "blue"), R
for shape in shapes_lst :
    print("Cost - ", shape.get_cost())

```

```

In [138... from abc import ABC, abstractmethod
class Shape(ABC) :
    prices = {"red" : 10, "blue":20, "green" : 30, "white" : 1}

    def __init__(self, color = None) :
        self.cal_area()
        self.color = color if color else "white"

    @abstractmethod

```

```

def cal_area(self) :
    pass

def get_cost(self, color = None) :
    color = color if color else self.color
    print(color)
    price = Shape.prices.get(color, 1)
    cost = self.area * price
    return cost

class Circle(Shape) :
    pi = 3.14 # Class variable

    def __init__(self, radius, color = None) : # Constructor
        self.radius = radius # instance variable | radius is local variable
        super().__init__(color)

    def cal_area(self) : # Method - belongs to instance
        self.area = Circle.pi * (self.radius ** 2)

class Rectangle(Shape) :
    def __init__(self, length, breadth):
        self.length = length
        self.breadth = breadth
        super().__init__()

    def cal_area(self):
        self.area = self.length * self.breadth

```

```

In [127... c = Circle(10)
           c.get_cost()

```

white

```

Out[127... 314.0

```

```

In [129... c = Circle(10)
           c.get_cost("red")

```

red

```

Out[129... 3140.0

```

```

In [130... c = Circle(10, "red")
           c.get_cost()

```

red

```

Out[130... 3140.0

```

```

In [131... c = Circle(10, "red")
           c.get_cost("blue")

```

blue

```

Out[131... 6280.0

```

```

In [137... Rectangle(10, 20)

```

-----  
**TypeError**

Traceback (most recent call last)

Cell In[137], line 1

----> 1 Rectangle(10, 20)

**TypeError**: Can't instantiate abstract class Rectangle without an implementation for abstract method 'cal\_area'

## Multiple Inheritance and Method Resolution Order

In [139...

```
class E :  
    pass  
  
class A :  
    pass  
  
class B(A, E) :  
    pass  
  
class C(A) :  
    pass  
  
class D(B,C) :  
    pass  
  
D.mro()
```

Out[139...] [`__main__.D`, `__main__.B`, `__main__.C`, `__main__.A`, `__main__.E`, `object`]

In [140...

```
class E :  
    pass  
  
class A :  
    pass  
  
class B(A, E) :  
    pass  
  
class C() :  
    pass  
  
class D(B,C) :  
    pass  
  
D.mro()
```

Out[140...] [`__main__.D`, `__main__.B`, `__main__.A`, `__main__.E`, `__main__.C`, `object`]

---

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## Handling data from external sources

## Introduction to OS module

```
In [142... import os
```

```
In [143... os.getcwd()
```

```
Out[143... 'T:\\Material_general\\Oracle\\Oracle_Nov_2024\\Classwork'
```

```
In [144... os.chdir(r"T:\Material_general\Oracle\Oracle_Nov_2024\Classwork")
```

## File Source

- The key function for working with files in Python is the `open()` function.
- The `open()` function takes two parameters; filename, and mode.
- There are four different methods (modes) for opening a file:
  - "r" - Read - Default value. Opens a file for reading, error if the file does not exist
  - "a" - Append - Opens a file for appending, creates the file if it does not exist
  - "w" - Write - Opens a file for writing, creates the file if it does not exist
- `file.read()` - reads the entire content as str obj
- `file.seek( index )` - navigates to the mentioned cursor position in the file
- `file.tell()` - returns the current cursor position

### Ex. Read file `customers.txt`

```
In [ ]: file = open("customers.txt")  
data = file.readlines()  
file.close()
```

### Ex. Print numbers of lines in the file

```
In [148... len(data)
```

```
Out[148... 9999
```

### Ex. Clean data read from the file and extract information about all `Pilots` .

```
In [165... class Customer:  
    def __init__(self, c_id, fname, lname, age, profession):  
        self.c_id = c_id  
        self.name = fname + " " + lname  
        self.age = int(age)
```



```

        self.profession = profession

def clean_data(strg):
    lst = strg.strip().split(",")
    cust = Customer(*lst)
    return cust

customers = [clean_data(i) for i in data] # using comprehension
# or
customers = tuple(map(clean_data, data )) # using map function

```

In [169... `pilots = list(filter(lambda cust : cust.profession == "Pilot", customers))`  
`len(pilots)`

Out[169... 209

**Ex. Write names of the pilots to `pilots.txt` file**

In [170... `file = open("pilots.txt", "w")`  
`for cust in customers :`  
 `file.write(cust.name + "\n")`  
`file.close()`

## Overriding the default methods

In [206... `class Customer:`  
 `def __init__(self, c_id, fname, lname, age, profession):`  
 `self.c_id = c_id`  
 `self.name = fname + " " + lname`  
 `self.age = int(age)`  
 `self.profession = profession`  
  
 `def __repr__(self):`  
 `return self.name`  
  
 `def __str__(self):`  
 `return f"{self.name} | {self.age} | {self.profession}"`  
  
 `def __lt__(self, obj) :`  
 `return self.age < obj.age`  
  
`def clean_data(strg):`  
 `lst = strg.strip().split(",")`  
 `cust = Customer(*lst)`  
 `return cust`  
  
`customers = [clean_data(i) for i in data] # using comprehension`

In [198... `customers[0] # checks for __repr__()`

Out[198... Kristina Chung

In [194... `print(customers[0]) # checks for __str__() if not present checks for __repr__()`

Kristina Chung | 55 | Pilot

In [195... `str(customers[0])` *# checks for `__str__()` if not present checks for `__repr__()`*

Out[195... `'Kristina Chung | 55 | Pilot'`

In [199... `customers[0:3]` *# objects in the list are printed using `__repr__()` expression*

Out[199... `[Kristina Chung, Paige Chen, Sherri Melton]`

**Sort the customers in the ASC order of their names (HINT - use `sorted()`)**

In [205... `sorted(customers, key = lambda cust : cust.age)`

Out[205... [Shirley Merritt,  
Kristin Alexander,  
Gail Whitehead,  
Donna Rice,  
Russell Dalton,  
Russell Hess,  
Peter Guthrie,  
Janice Bowden,  
Jason Bowling,  
Ian Hodges,  
Toni Byers,  
Edwin Ball,  
Brandon Nance,  
Lindsay Reynolds,  
Paige Wolfe,  
Nina Humphrey,  
Derek Foster,  
Penny Lu,  
Vanessa Franklin,  
Carole Rogers,  
Kristine Brown,  
Gilbert Ball,  
Charlene Snow,  
Stephanie Levine,  
Edwin Lim,  
Erin Marsh,  
Barry Bowles,  
Russell Huang,  
Valerie Smith,  
Paula Jiang,  
Stacey Stroud,  
Greg Michael,  
Bruce Werner,  
Yvonne Andrews,  
Stanley Frost,  
Derek Dudley,  
Henry Bond,  
Carol Weaver,  
Tommy Parrott,  
Bernard Kerr,  
Jonathan Wolf,  
Tara Hess,  
Terry Palmer,  
Annette Lane,  
Leigh Doyle,  
Michele Vick,  
Elisabeth Bowers,  
Maureen Oliver,  
Steven Chu,  
Kevin Blackburn,  
Jay Stephenson,  
Edgar Jackson,  
Emma Paul,  
Brett Matthews,  
Maureen Fischer,  
Lois Dyer,

Vanessa Yu,  
Paula Lang,  
Marjorie Poe,  
Toni Maxwell,  
Glenda Manning,  
Beth Oakley,  
Pam Adcock,  
Grace Parrish,  
Brent Strickland,  
Seth Roach,  
Frank Hendrix,  
Dan Carson,  
Valerie Kent,  
Laurence Stevens,  
Howard Abrams,  
Cecil Lynn,  
Katie Connor,  
Rebecca Abrams,  
Brooke Harvey,  
Vicki Randall,  
Eddie Potter,  
Chris Barbee,  
Yvonne Burnett,  
Dana McKay,  
Jenny Stokes,  
Vernon Shapiro,  
Stacy Barton,  
Bonnie Stephens,  
Holly Koch,  
Wanda Byrne,  
Geraldine Yu,  
Edith Siegel,  
Sandy Jacobs,  
Peggy Russell,  
Jerry Simon,  
Megan Hamrick,  
Joshua Daniel,  
Robyn Lyon,  
Edwin Williamson,  
John Eason,  
Sarah Cochran,  
Debra Park,  
Nicole Church,  
Charles Porter,  
Kyle Sigmon,  
Priscilla Freeman,  
Leo Rankin,  
Jennifer Kirk,  
Lorraine Beck,  
Jay Becker,  
Leigh Edwards,  
Gordon House,  
Karl Adams,  
Herbert Jones,  
Jill Barnes,  
Emma Ball,

Geraldine Mitchell,  
Stacey Rouse,  
Judith Cooper,  
Vincent Goldman,  
Brett Snyder,  
Leon Bender,  
Virginia Turner,  
Kristin Drake,  
Danielle Smith,  
Thelma Hale,  
Claire Bishop,  
Holly Hardy,  
Faye Moon,  
Heather Levy,  
Eugene Shah,  
Rodney Cook,  
Allison Adams,  
Dorothy Bell,  
Larry Lamm,  
Juan Andrews,  
Tracy Gillespie,  
Peggy Kramer,  
Rosemary Boyle,  
Johnny Gibbons,  
Linda Dolan,  
Julia Case,  
Cecil Conner,  
Natalie Silver,  
Frank Marcus,  
Marlene Davenport,  
Tara McLaughlin,  
Michelle Stern,  
Thelma Sherman,  
Anna Bruce,  
Annie Pugh,  
Andrew McAllister,  
Frederick Case,  
Douglas McNeill,  
Kathleen Chen,  
Christine Klein,  
Cynthia Barr,  
Gail Andrews,  
Theodore Cole,  
Phyllis Cobb,  
Claire Craven,  
Kristin George,  
Florence Chambers,  
Alex Leach,  
Jessie Barber,  
Sharon Merrill,  
Lindsay Aldridge,  
Ryan Kirby,  
Tim Wagner,  
Max Schultz,  
Marian Parrott,  
Keith Joyce,

Guy Church,  
Annette Hahn,  
Marguerite Bunn,  
Lynn Barnes,  
Nelson Honeycutt,  
Leslie Pugh,  
Stacy May,  
Lloyd Henson,  
Meredith Pittman,  
Laura Carey,  
Jeanne Conway,  
Lauren Keith,  
Emily Mitchell,  
Bill Elmore,  
Daniel Archer,  
Jill Singleton,  
Leslie Ross,  
Wanda Schneider,  
Danny Barrett,  
Neil Gold,  
Michael Nichols,  
Carmen Hartman,  
Don Ayers,  
Claudia Sims,  
Karen Kennedy,  
Benjamin Moody,  
Rebecca Gardner,  
Jesse Kerr,  
Ron Gallagher,  
Timothy Jacobson,  
Greg Anderson,  
Paula Sparks,  
George Kendall,  
Harriet Wade,  
Christine Barrett,  
Peter Perez,  
Tara Duke,  
Peggy Langley,  
Joshua Blanton,  
Ruth Lloyd,  
Katharine Powell,  
Edgar Alexander,  
Norma Everett,  
Marion Buchanan,  
Lauren Dickerson,  
Yvonne Waters,  
Roger Hanna,  
Milton Starr,  
Ted Weinstein,  
Allison Choi,  
Florence McFarland,  
Hannah Wall,  
Ethel Stevens,  
Audrey Law,  
Kim McCormick,  
Regina Gregory,

Cecil Bruce,  
Laurie Porter,  
Robyn Keith,  
Dan Goldman,  
Bruce Kaufman,  
Elisabeth Carroll,  
Marie Mack,  
Donna Dudley,  
Cynthia Forbes,  
Holly Solomon,  
Harriet McLeod,  
Bryan Howell,  
Randall Byrne,  
Sean Oakley,  
Sally Myers,  
Kevin Snow,  
Kim Bolton,  
Angela Alexander,  
Toni Dickerson,  
Kenneth Gorman,  
Joyce Godfrey,  
Meredith Wu,  
Phyllis Duffy,  
Jim Anthony,  
Harold Webb,  
Catherine Wiggins,  
Pamela Huang,  
Allan Bond,  
Lucy Bowers,  
Brian Jernigan,  
Molly Browning,  
Tara Bowers,  
Christine Ballard,  
Cheryl Lutz,  
Joel Donnelly,  
Peter Rice,  
Gail Best,  
Ryan Swanson,  
Glenda Kessler,  
Seth Cochran,  
Toni Guthrie,  
Kathleen Lindsay,  
Don Hall,  
Kent Simmons,  
Jeffrey Holden,  
Evan Wise,  
Susan Keith,  
Eileen Miller,  
Sally Stephens,  
Wayne Marsh,  
Pat McDowell,  
Edward Bauer,  
Paul O'Connor,  
James Rhodes,  
Penny Lloyd,  
Kerry Mitchell,

Edith Bloom,  
Toni Currie,  
Alvin Lambert,  
Marguerite Jones,  
Kerry Tan,  
Albert Higgins,  
Greg Beard,  
Tamara Cain,  
Jason McFarland,  
Timothy Norris,  
Jonathan Pearson,  
Sheryl Yu,  
Charlie O'Donnell,  
Malcolm Camp,  
Scott Larson,  
Kathy Forbes,  
Seth Hedrick,  
Erika Francis,  
Jamie Townsend,  
Samantha Gross,  
Lee Weber,  
Joe Vogel,  
Sarah West,  
Scott McGuire,  
Brenda Knox,  
Christian Silver,  
Wesley McKay,  
Tammy Blackburn,  
Eleanor Warren,  
Miriam Hanson,  
Nina McMillan,  
Ray Underwood,  
Rita Holder,  
Phillip Carey,  
Donna Hale,  
Cheryl Chan,  
Jimmy Heller,  
Erin McKenzie,  
Terri Gibbs,  
Doris Simpson,  
Kimberly Wang,  
Frederick Wagner,  
Gretchen Goldstein,  
Natalie Walton,  
Leon Pearson,  
Ashley Houston,  
Jeanne Crabtree,  
Amanda Kirby,  
Luis Zhang,  
Clyde Howe,  
Ellen Chappell,  
Tiffany Cannon,  
Molly Farmer,  
Kate Langley,  
Melanie Melton,  
Derek Riley,



Marcia Sparks,  
Jimmy Schroeder,  
Molly Strauss,  
Henry Potter,  
Phyllis Mercer,  
Stacey Kaufman,  
Juanita Cox,  
Nelson Lyons,  
Paul Lester,  
Glenn Martin,  
Tracy Proctor,  
Bob Jacobs,  
Marsha Cash,  
Ray Lam,  
Sherry Adcock,  
Jay Chase,  
Daniel Pittman,  
Ernest Sawyer,  
Joe Feldman,  
Susan Hardy,  
Ashley Christian,  
Edward Mueller,  
Kyle Tyson,  
Glen Wood,  
Lester Hodges,  
Nicole Tan,  
Sean Pickett,  
Neil Hull,  
Clara Gibson,  
Evan Rosenthal,  
Joann Coble,  
Shelley Melvin,  
Jane Roberts,  
Vicki Carver,  
Evelyn Rhodes,  
Jessie McLean,  
Katherine Hewitt,  
Tony Adams,  
Martha Hewitt,  
Sean Bernstein,  
Paula Atkins,  
Linda Wilkerson,  
Dorothy Beach,  
Carole Jordan,  
Carlos Davies,  
Sheryl Bradford,  
Brent Allison,  
Katie Kerr,  
Timothy Davies,  
Thomas Braun,  
Patricia Ferrell,  
Frances Hanna,  
Gregory Schneider,  
Emily Bland,  
Joanna McKee,  
Vicki Parsons,

Becky Bailey,  
Caroline Spears,  
Paige Rollins,  
Deborah Shelton,  
Melanie Butler,  
Michelle Bradshaw,  
Laurie Herbert,  
Ruby Sawyer,  
Danny Barber,  
Christine Gunter,  
Colleen Cannon,  
Carlos Greenberg,  
Jenny Bland,  
Albert Ellis,  
Leah Kinney,  
Todd Clark,  
Clifford Wooten,  
Priscilla Reed,  
Leo Pratt,  
Louise Talley,  
Elisabeth Lewis,  
Ronald Wallace,  
Don Doyle,  
Stephen Wilkinson,  
Bruce Case,  
Esther Pickett,  
Gordon Morrison,  
Christian Yates,  
Jim Burnette,  
Harriet Sloan,  
Monica Wright,  
Judy Barr,  
Erika Boyle,  
Jack Walsh,  
Tonya Gill,  
Max Porter,  
Joe Whitley,  
Kurt Levine,  
Anthony Hutchinson,  
Debbie Sharma,  
Shelley Weeks,  
Stacy Olsen,  
Keith Chandler,  
Tamara Hunt,  
Mary Cochran,  
Hannah Langston,  
Edwin Curtis,  
Allison Norman,  
Clyde Kenney,  
Kyle Bolton,  
Ben Puckett,  
Miriam Berg,  
Ann Chandler,  
Katherine Sutherland,  
Phyllis Byers,  
Marianne Mayo,

Christina Hubbard,  
Annie Lucas,  
Samuel Goodwin,  
Debbie Chappell,  
Patrick Padgett,  
Vickie Stephens,  
Alice Garrett,  
Gerald Walsh,  
Scott Donnelly,  
Frank Fleming,  
Vicki Gould,  
Jeff Hunt,  
Charlie Glover,  
Samantha Conrad,  
William Sherrill,  
Chris Cochran,  
James Cochran,  
Gladys Dorsey,  
Steven Townsend,  
Janice McMahon,  
Charlotte Meyer,  
Victor Capps,  
Shirley Hansen,  
Crystal Martinez,  
Sharon Cooper,  
Maria Avery,  
Zachary Long,  
Carrie Hardin,  
Jennifer Hobbs,  
Jordan Giles,  
Marsha Pollard,  
Ruth Clark,  
John Archer,  
Julie Bloom,  
Kathy Thomson,  
Teresa Kay,  
Kara Simmons,  
Thelma Byers,  
Jonathan Yang,  
Lindsay Norton,  
Jackie Desai,  
Lorraine Jensen,  
Lillian Walton,  
Lynne Stokes,  
Shawn Buckley,  
Louis Haas,  
Glen Baldwin,  
Benjamin Wood,  
Katharine Hall,  
Bonnie Washington,  
Dolores Benton,  
Gloria Henson,  
Alan Boyle,  
Edward Russell,  
Deborah Byrd,  
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Suzanne Maxwell,  
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Mary Stevens,  
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Luis Everett,  
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Marjorie Fitzgerald,  
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Christopher Myers,  
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Philip Kramer,  
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Philip Cunningham,  
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Irene Cates,  
Regina Hubbard,  
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Ken Marshall,  
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Lori Lang,  
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Jose Dale,  
Edward Prince,  
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Elisabeth Foster,  
Cindy Glass,  
Calvin Crawford,  
William Dickson,  
Neal McNeill,  
Jimmy Stark,  
Lori Knowles,

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Rick Pridgen,  
Evelyn Hunter,  
Ronnie Perry,  
Joel Han,  
Karl Wrenn,  
Jim Hurley,  
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Kathleen Hodges,  
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Earl Osborne,  
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Bonnie Mann,  
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Ian Hester,  
Renee Clarke,  
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Ted Cassidy,  
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Tom Owen,  
Francis Wise,

Carolyn Willis,  
Jill Neal,  
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Judy Tuttle,

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Theresa McDonald,  
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Wesley Douglas,  
Ken Hewitt,



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Edith Briggs,  
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Philip Peele,  
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Rachel Sutton,  
Kristin Leonard,  
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Samantha Hardin,  
Scott Golden,  
Terry Barton,  
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Jill Kent,  
Malcolm Chan,  
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Catherine Summers,  
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Alvin Frederick,  
Gary Scarborough,  
Shelley Dunn,  
Billy Carroll,  
Richard Harris,  
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Greg Berger,  
Paige Dudley,  
George Mathews,

Sylvia Hsu,  
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Allen Randall,  
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Jeff Dodson,  
Tony Fletcher,  
Ross Hawkins,  
Marcus Howe,  
Sidney Frye,  
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Sean Snow,  
Amy Peters,  
Bryan Weiss,  
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Ronnie Myers,  
Aaron McKenzie,  
Sam Blum,  
Robyn Dickinson,  
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Ken Ritchie,  
Stacy Floyd,  
Glenn Phelps,  
Juanita Lanier,  
Roy Gentry,  
Karen Noble,  
Tracy Sparks,  
James Kang,  
Ruth Bass,  
Adam Carroll,  
Annie Lim,  
Howard French,  
Andrew Rowland,  
Terry Schultz,  
Russell Park,  
Bryan Kennedy,  
Jessica Friedman,  
Glenda Parrish,  
Raymond Crane,  
Leah McCoy,  
Joel Blanchard,  
Veronica Gates,  
Ronnie Boone,  
Sharon Baxter,  
Dwight Arnold,  
Marcus Moran,  
Becky English,  
Bruce Hoyle,  
Carla Ward,  
Priscilla George,  
Ralph Tate,

Laurence Benson,  
Joe Lloyd,  
Louis Langley,  
Dean Hoyle,  
James Burnette,  
Vivian Albright,  
Erin Austin,  
Wendy Poe,  
Bernice Powell,  
Kevin Phillips,  
Pauline Katz,  
Nina Pratt,  
Lori Ritchie,  
Ann Braswell,  
Tony Weeks,  
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Elizabeth Hayes,  
Heidi Blake,  
Scott Knowles,  
Mary Hancock,  
Dale Gorman,  
Evan Singer,  
Brooke Reid,  
Arthur McCarthy,  
Connie Conrad,  
Jane Spivey,  
Renee McNamara,  
Hannah Buchanan,  
Arlene Armstrong,  
Jordan Perkins,  
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Nathan Callahan,  
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Heather Huff,  
Joel Woodard,  
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Emma Kearney,  
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Troy Monroe,  
Elisabeth Feldman,  
Peter Starr,  
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Marion Mayer,  
Jimmy Holloway,  
Martin Houston,  
Vernon Brock,  
Lynn Silverman,  
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Erica Best,  
Ryan Strauss,

Vanessa Walsh,  
Glenda Howard,  
Matthew Hobbs,  
Victor Deal,  
Brenda Hodge,  
Laura Griffin,  
Rita Keller,  
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Leonard Greene,  
Laurie McNeill,  
Sidney Schultz,  
Marshall White,  
Dan Richmond,  
April Gardner,  
Annette Horner,  
Jeanette Barbee,  
Diana Rivera,  
Jenny Beasley,  
Kim Russell,  
Yvonne Swain,  
Kevin Beatty,  
Carlos Block,  
Tony Byrd,  
Gwendolyn Sweeney,  
Erik Christian,  
Robertta Hood,  
Leroy Michael,  
Vernon Hansen,  
Bradley Dougherty,  
Katie Kelly,  
Tonya Bridges,  
Sharon Simpson,  
Vanessa Meadows,  
Kathryn Foley,  
Randall Ivey,  
Audrey West,  
Cindy McLamb,  
Gary Saunders,  
Tara Parks,  
Alvin McKenna,  
Julie Lindsey,  
Tina Flowers,  
Angela Jernigan,  
Tom Fitzgerald,  
Annie Knowles,  
Albert Wiley,  
Theodore Gould,  
Franklin Vick,  
...]

In [204...

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sorted(customers, key = lambda cust : cust.name)
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Adam Woodard,  
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Alan McConnell,  
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Alexander Carver,  
Alexander Desai,  
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Alexandra Barnett,  
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Alexandra Cox,  
Alexandra Decker,  
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Alexandra Helms,  
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Alexandra Johnson,  
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Alexandra Marsh,  
Alexandra Pennington,  
Alexandra Small,  
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Alexandra Warren,  
Alexandra Weiss,  
Alfred Burton,  
Alfred Chen,  
Alfred Clements,  
Alfred Davenport,  
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Alice Davis,  
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Alice Hill,  
Alice Jacobson,  
Alice Jordan,  
Alice Merritt,

Alice Nance,  
Alice Norton,  
Alice O'Connell,  
Alice Reddy,  
Alice Robbins,  
Alice Shah,  
Alice Steele,  
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Alicia Dunlap,  
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Allen Floyd,



Allen Goldstein,  
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Arnold Lin,  
Arnold Mueller,  
Arnold Pearson,  
Arnold Simon,  
Arnold Walton,  
Arnold Washington,  
Arnold West,  
Arthur Bell,  
Arthur Bender,  
Arthur Berger,  
Arthur Buckley,  
Arthur Cheek,  
Arthur Chu,  
Arthur Coble,  
Arthur Glass,  
Arthur Gold,  
Arthur Goldberg,  
Arthur Goldman,  
Arthur Hampton,  
Arthur Harrington,  
Arthur Hawkins,  
Arthur Holden,  
Arthur Kramer,  
Arthur Lucas,  
Arthur McCarthy,  
Arthur McCullough,  
Arthur McKenna,  
Arthur Shannon,  
Arthur Singer,  
Arthur Willis,  
Arthur Wolf,  
Ashley Beatty,

Ashley Berry,  
Ashley Brady,  
Ashley Brandon,  
Ashley Christian,  
Ashley Coble,  
Ashley Corbett,  
Ashley Creech,  
Ashley Dale,  
Ashley Dalton,  
Ashley Dixon,  
Ashley Gupta,  
Ashley Hendrix,  
Ashley Houston,  
Ashley McGee,  
Ashley Norton,  
Ashley Page,  
Ashley Pearson,  
Ashley Ross,  
Ashley Thomas,  
Ashley Townsend,  
Ashley Webster,  
Ashley Wright,  
Ashley Xu,  
Audrey Block,  
Audrey Bryant,  
Audrey Chan,  
Audrey Cross,  
Audrey Diaz,  
Audrey English,  
Audrey Field,  
Audrey Forrest,  
Audrey Garcia,  
Audrey Gentry,  
Audrey Gray,  
Audrey Hansen,  
Audrey Kelly,  
Audrey Kern,  
Audrey Lanier,  
Audrey Law,  
Audrey Long,  
Audrey Morrison,  
Audrey Olsen,  
Audrey Olson,  
Audrey Padgett,  
Audrey Schwartz,  
Audrey West,  
Audrey Williford,  
Audrey Woodward,  
Barbara Bean,  
Barbara Bernstein,  
Barbara Blalock,  
Barbara Clayton,  
Barbara Creech,  
Barbara Erickson,  
Barbara Hardin,  
Barbara Herbert,



Barbara McKenna,  
Barbara Morgan,  
Barbara Moss,  
Barbara Pierce,  
Barbara Pritchard,  
Barbara Rose,  
Barbara Smith,  
Barry Barr,  
Barry Bowles,  
Barry Fox,  
Barry Gordon,  
Barry Guthrie,  
Barry King,  
Barry Maynard,  
Barry Mitchell,  
Barry Sykes,  
Barry Thompson,  
Becky Bailey,  
Becky Covington,  
Becky Diaz,  
Becky English,  
Becky Fischer,  
Becky Henry,  
Becky Herndon,  
Becky Hull,  
Becky Kay,  
Becky Kennedy,  
Becky Lewis,  
Becky Martinez,  
Becky May,  
Becky McKinney,  
Becky Moser,  
Becky Newton,  
Becky Parsons,  
Becky Sherman,  
Becky Wolfe,  
Ben Banks,  
Ben Bender,  
Ben Bennett,  
Ben Blackwell,  
Ben Bowling,  
Ben Burton,  
Ben Chapman,  
Ben Frazier,  
Ben George,  
Ben McKenzie,  
Ben Murphy,  
Ben Patton,  
Ben Proctor,  
Ben Puckett,  
Ben Roy,  
Ben Stephens,  
Ben West,  
Ben Whitaker,  
Ben Williams,  
Ben Wu,

Benjamin Atkinson,  
Benjamin Ballard,  
Benjamin Blackburn,  
Benjamin Crabtree,  
Benjamin Daniel,  
Benjamin Finley,  
Benjamin French,  
Benjamin Hall,  
Benjamin Hart,  
Benjamin Hensley,  
Benjamin Justice,  
Benjamin Kelly,  
Benjamin Lambert,  
Benjamin Moody,  
Benjamin Park,  
Benjamin Pennington,  
Benjamin Pitts,  
Benjamin Quinn,  
Benjamin Roach,  
Benjamin Rowe,  
Benjamin Sanchez,  
Benjamin Simmons,  
Benjamin Stallings,  
Benjamin Sutton,  
Benjamin Waller,  
Benjamin Willis,  
Benjamin Wood,  
Benjamin York,  
Bernard Adams,  
Bernard Booth,  
Bernard Bowers,  
Bernard Coley,  
Bernard Goodman,  
Bernard Johnson,  
Bernard Kang,  
Bernard Kerr,  
Bernard McCarthy,  
Bernard Morse,  
Bernard Moser,  
Bernard Pate,  
Bernard Price,  
Bernard Reilly,  
Bernard Schultz,  
Bernard Zhou,  
Bernice Day,  
Bernice Douglas,  
Bernice Fleming,  
Bernice Gardner,  
Bernice Lanier,  
Bernice Lawrence,  
Bernice Lindsay,  
Bernice McCoy,  
Bernice Nguyen,  
Bernice Parks,  
Bernice Powell,  
Bernice Richardson,

Bernice Stark,  
Beth Cho,  
Beth Conner,  
Beth Dodson,  
Beth Donnelly,  
Beth Fitzgerald,  
Beth Gonzalez,  
Beth Hayes,  
Beth Horowitz,  
Beth Howe,  
Beth Lin,  
Beth McClure,  
Beth McKenna,  
Beth Morrow,  
Beth Oakley,  
Beth Rubin,  
Beth Scott,  
Beth Snow,  
Beth Strauss,  
Beth Swanson,  
Beth Walton,  
Beth Weber,  
Beth Willis,  
Beth Woodard,  
Betsy Alford,  
Betsy Beatty,  
Betsy Bradford,  
Betsy Brandon,  
Betsy Burke,  
Betsy Byers,  
Betsy Carr,  
Betsy Casey,  
Betsy Chang,  
Betsy Cochran,  
Betsy Connolly,  
Betsy Denton,  
Betsy Epstein,  
Betsy Hampton,  
Betsy Heath,  
Betsy Hudson,  
Betsy McCullough,  
Betsy McLean,  
Betsy McMahon,  
Betsy Nash,  
Betsy Nelson,  
Betsy Rivera,  
Betsy Schneider,  
Betsy Singh,  
Betsy Skinner,  
Betsy Snow,  
Betsy Tuttle,  
Betty Albright,  
Betty Bass,  
Betty Bond,  
Betty Campbell,  
Betty Carlton,

Betty Chapman,  
Betty Fleming,  
Betty Gates,  
Betty Grady,  
Betty Hansen,  
Betty Lopez,  
Betty Love,  
Betty McGee,  
Betty McKenzie,  
Betty Noble,  
Betty Norman,  
Betty Rankin,  
Betty Stout,  
Betty Waters,  
Beverly Bean,  
Beverly Boyd,  
Beverly Bryant,  
Beverly Carter,  
Beverly Chang,  
Beverly Davenport,  
Beverly Finch,  
Beverly Frank,  
Beverly Graves,  
Beverly Joseph,  
Beverly Long,  
Beverly Lutz,  
Beverly Maxwell,  
Beverly McLaughlin,  
Beverly Spivey,  
Beverly Stanley,  
Beverly Sutherland,  
Bill Boyette,  
Bill Collins,  
Bill Cross,  
Bill Edwards,  
Bill Elmore,  
Bill Heath,  
Bill Klein,  
Bill Lehman,  
Bill Mullen,  
Bill Oakley,  
Bill Roberson,  
Bill Schroeder,  
Bill Strickland,  
Bill Watts,  
Bill Wiggins,  
Billie Berry,  
Billie Bullard,  
Billie Dawson,  
Billie Durham,  
Billie Farmer,  
Billie Fuller,  
Billie Grady,  
Billie Herring,  
Billie Hester,  
Billie House,

Billie Mayer,  
Billie Miller,  
Billie Moss,  
Billie Pierce,  
Billie Rosenthal,  
Billie Sanford,  
Billie Sharma,  
Billie Sutherland,  
Billie Tucker,  
Billie Ward,  
Billy Brooks,  
Billy Bryan,  
Billy Carroll,  
Billy Denton,  
Billy High,  
Billy Holder,  
Billy Horton,  
Billy Li,  
Billy Mitchell,  
Billy Pritchard,  
Billy Roberson,  
Billy Rodgers,  
Billy Sherrill,  
Billy Strauss,  
Billy Teague,  
Billy Tilley,  
Billy Wade,  
Billy Wang,  
Bob Cole,  
Bob Denton,  
Bob Fischer,  
Bob Frye,  
Bob Gilbert,  
Bob Harding,  
Bob Harrell,  
Bob Herndon,  
Bob Jacobs,  
Bob Jones,  
Bob McKinney,  
Bob Nichols,  
Bob Pugh,  
Bob Robertson,  
Bob Roth,  
Bob Schroeder,  
Bob Sutton,  
Bob Tate,  
Bob Walter,  
Bobby Ashley,  
Bobby Blum,  
Bobby Bradley,  
Bobby Case,  
Bobby Cho,  
Bobby Fitzgerald,  
Bobby Gray,  
Bobby Harrell,  
Bobby Hill,

Bobby Hines,  
Bobby Hsu,  
Bobby Lane,  
Bobby Mann,  
Bobby Rao,  
Bobby Sawyer,  
Bobby Walter,  
Bobby Williamson,  
Bobby Zhu,  
Bonnie Baird,  
Bonnie Ballard,  
Bonnie Benton,  
Bonnie Blum,  
Bonnie Brantley,  
Bonnie Camp,  
Bonnie Dale,  
Bonnie Davis,  
Bonnie Friedman,  
Bonnie Goodwin,  
Bonnie Heath,  
Bonnie Hines,  
Bonnie Hudson,  
Bonnie Kent,  
Bonnie Mann,  
Bonnie Marcus,  
Bonnie McDaniel,  
Bonnie Smith,  
Bonnie Stephens,  
Bonnie Tyler,  
Bonnie Washington,  
Bonnie Wells,  
Bonnie Wilder,  
Brad Ballard,  
Brad Barbee,  
Brad Bean,  
Brad Carver,  
Brad Eason,  
Brad Hess,  
Brad Jacobson,  
Brad Kenney,  
Brad Kirkland,  
Brad McBride,  
Brad McKee,  
Brad Miles,  
Brad Morrow,  
Brad Ray,  
Brad Richards,  
Brad Sanford,  
...]

In [207... `customers[0] < customers[1]`

Out[207... `True`

In [208... `customers[0].age, customers[1].age`

Out[208... (55, 74)

In [209... `sorted(customers)`

Out[209... [Shirley Merritt,  
Kristin Alexander,  
Gail Whitehead,  
Donna Rice,  
Russell Dalton,  
Russell Hess,  
Peter Guthrie,  
Janice Bowden,  
Jason Bowling,  
Ian Hodges,  
Toni Byers,  
Edwin Ball,  
Brandon Nance,  
Lindsay Reynolds,  
Paige Wolfe,  
Nina Humphrey,  
Derek Foster,  
Penny Lu,  
Vanessa Franklin,  
Carole Rogers,  
Kristine Brown,  
Gilbert Ball,  
Charlene Snow,  
Stephanie Levine,  
Edwin Lim,  
Erin Marsh,  
Barry Bowles,  
Russell Huang,  
Valerie Smith,  
Paula Jiang,  
Stacey Stroud,  
Greg Michael,  
Bruce Werner,  
Yvonne Andrews,  
Stanley Frost,  
Derek Dudley,  
Henry Bond,  
Carol Weaver,  
Tommy Parrott,  
Bernard Kerr,  
Jonathan Wolf,  
Tara Hess,  
Terry Palmer,  
Annette Lane,  
Leigh Doyle,  
Michele Vick,  
Elisabeth Bowers,  
Maureen Oliver,  
Steven Chu,  
Kevin Blackburn,  
Jay Stephenson,  
Edgar Jackson,  
Emma Paul,  
Brett Matthews,  
Maureen Fischer,  
Lois Dyer,



Vanessa Yu,  
Paula Lang,  
Marjorie Poe,  
Toni Maxwell,  
Glenda Manning,  
Beth Oakley,  
Pam Adcock,  
Grace Parrish,  
Brent Strickland,  
Seth Roach,  
Frank Hendrix,  
Dan Carson,  
Valerie Kent,  
Laurence Stevens,  
Howard Abrams,  
Cecil Lynn,  
Katie Connor,  
Rebecca Abrams,  
Brooke Harvey,  
Vicki Randall,  
Eddie Potter,  
Chris Barbee,  
Yvonne Burnett,  
Dana McKay,  
Jenny Stokes,  
Vernon Shapiro,  
Stacy Barton,  
Bonnie Stephens,  
Holly Koch,  
Wanda Byrne,  
Geraldine Yu,  
Edith Siegel,  
Sandy Jacobs,  
Peggy Russell,  
Jerry Simon,  
Megan Hamrick,  
Joshua Daniel,  
Robyn Lyon,  
Edwin Williamson,  
John Eason,  
Sarah Cochran,  
Debra Park,  
Nicole Church,  
Charles Porter,  
Kyle Sigmon,  
Priscilla Freeman,  
Leo Rankin,  
Jennifer Kirk,  
Lorraine Beck,  
Jay Becker,  
Leigh Edwards,  
Gordon House,  
Karl Adams,  
Herbert Jones,  
Jill Barnes,  
Emma Ball,

Geraldine Mitchell,  
Stacey Rouse,  
Judith Cooper,  
Vincent Goldman,  
Brett Snyder,  
Leon Bender,  
Virginia Turner,  
Kristin Drake,  
Danielle Smith,  
Thelma Hale,  
Claire Bishop,  
Holly Hardy,  
Faye Moon,  
Heather Levy,  
Eugene Shah,  
Rodney Cook,  
Allison Adams,  
Dorothy Bell,  
Larry Lamm,  
Juan Andrews,  
Tracy Gillespie,  
Peggy Kramer,  
Rosemary Boyle,  
Johnny Gibbons,  
Linda Dolan,  
Julia Case,  
Cecil Conner,  
Natalie Silver,  
Frank Marcus,  
Marlene Davenport,  
Tara McLaughlin,  
Michelle Stern,  
Thelma Sherman,  
Anna Bruce,  
Annie Pugh,  
Andrew McAllister,  
Frederick Case,  
Douglas McNeill,  
Kathleen Chen,  
Christine Klein,  
Cynthia Barr,  
Gail Andrews,  
Theodore Cole,  
Phyllis Cobb,  
Claire Craven,  
Kristin George,  
Florence Chambers,  
Alex Leach,  
Jessie Barber,  
Sharon Merrill,  
Lindsay Aldridge,  
Ryan Kirby,  
Tim Wagner,  
Max Schultz,  
Marian Parrott,  
Keith Joyce,

Guy Church,  
Annette Hahn,  
Marguerite Bunn,  
Lynn Barnes,  
Nelson Honeycutt,  
Leslie Pugh,  
Stacy May,  
Lloyd Henson,  
Meredith Pittman,  
Laura Carey,  
Jeanne Conway,  
Lauren Keith,  
Emily Mitchell,  
Bill Elmore,  
Daniel Archer,  
Jill Singleton,  
Leslie Ross,  
Wanda Schneider,  
Danny Barrett,  
Neil Gold,  
Michael Nichols,  
Carmen Hartman,  
Don Ayers,  
Claudia Sims,  
Karen Kennedy,  
Benjamin Moody,  
Rebecca Gardner,  
Jesse Kerr,  
Ron Gallagher,  
Timothy Jacobson,  
Greg Anderson,  
Paula Sparks,  
George Kendall,  
Harriet Wade,  
Christine Barrett,  
Peter Perez,  
Tara Duke,  
Peggy Langley,  
Joshua Blanton,  
Ruth Lloyd,  
Katharine Powell,  
Edgar Alexander,  
Norma Everett,  
Marion Buchanan,  
Lauren Dickerson,  
Yvonne Waters,  
Roger Hanna,  
Milton Starr,  
Ted Weinstein,  
Allison Choi,  
Florence McFarland,  
Hannah Wall,  
Ethel Stevens,  
Audrey Law,  
Kim McCormick,  
Regina Gregory,

Cecil Bruce,  
Laurie Porter,  
Robyn Keith,  
Dan Goldman,  
Bruce Kaufman,  
Elisabeth Carroll,  
Marie Mack,  
Donna Dudley,  
Cynthia Forbes,  
Holly Solomon,  
Harriet McLeod,  
Bryan Howell,  
Randall Byrne,  
Sean Oakley,  
Sally Myers,  
Kevin Snow,  
Kim Bolton,  
Angela Alexander,  
Toni Dickerson,  
Kenneth Gorman,  
Joyce Godfrey,  
Meredith Wu,  
Phyllis Duffy,  
Jim Anthony,  
Harold Webb,  
Catherine Wiggins,  
Pamela Huang,  
Allan Bond,  
Lucy Bowers,  
Brian Jernigan,  
Molly Browning,  
Tara Bowers,  
Christine Ballard,  
Cheryl Lutz,  
Joel Donnelly,  
Peter Rice,  
Gail Best,  
Ryan Swanson,  
Glenda Kessler,  
Seth Cochran,  
Toni Guthrie,  
Kathleen Lindsay,  
Don Hall,  
Kent Simmons,  
Jeffrey Holden,  
Evan Wise,  
Susan Keith,  
Eileen Miller,  
Sally Stephens,  
Wayne Marsh,  
Pat McDowell,  
Edward Bauer,  
Paul O'Connor,  
James Rhodes,  
Penny Lloyd,  
Kerry Mitchell,

Edith Bloom,  
Toni Currie,  
Alvin Lambert,  
Marguerite Jones,  
Kerry Tan,  
Albert Higgins,  
Greg Beard,  
Tamara Cain,  
Jason McFarland,  
Timothy Norris,  
Jonathan Pearson,  
Sheryl Yu,  
Charlie O'Donnell,  
Malcolm Camp,  
Scott Larson,  
Kathy Forbes,  
Seth Hedrick,  
Erika Francis,  
Jamie Townsend,  
Samantha Gross,  
Lee Weber,  
Joe Vogel,  
Sarah West,  
Scott McGuire,  
Brenda Knox,  
Christian Silver,  
Wesley McKay,  
Tammy Blackburn,  
Eleanor Warren,  
Miriam Hanson,  
Nina McMillan,  
Ray Underwood,  
Rita Holder,  
Phillip Carey,  
Donna Hale,  
Cheryl Chan,  
Jimmy Heller,  
Erin McKenzie,  
Terri Gibbs,  
Doris Simpson,  
Kimberly Wang,  
Frederick Wagner,  
Gretchen Goldstein,  
Natalie Walton,  
Leon Pearson,  
Ashley Houston,  
Jeanne Crabtree,  
Amanda Kirby,  
Luis Zhang,  
Clyde Howe,  
Ellen Chappell,  
Tiffany Cannon,  
Molly Farmer,  
Kate Langley,  
Melanie Melton,  
Derek Riley,

Marcia Sparks,  
Jimmy Schroeder,  
Molly Strauss,  
Henry Potter,  
Phyllis Mercer,  
Stacey Kaufman,  
Juanita Cox,  
Nelson Lyons,  
Paul Lester,  
Glenn Martin,  
Tracy Proctor,  
Bob Jacobs,  
Marsha Cash,  
Ray Lam,  
Sherry Adcock,  
Jay Chase,  
Daniel Pittman,  
Ernest Sawyer,  
Joe Feldman,  
Susan Hardy,  
Ashley Christian,  
Edward Mueller,  
Kyle Tyson,  
Glen Wood,  
Lester Hodges,  
Nicole Tan,  
Sean Pickett,  
Neil Hull,  
Clara Gibson,  
Evan Rosenthal,  
Joann Coble,  
Shelley Melvin,  
Jane Roberts,  
Vicki Carver,  
Evelyn Rhodes,  
Jessie McLean,  
Katherine Hewitt,  
Tony Adams,  
Martha Hewitt,  
Sean Bernstein,  
Paula Atkins,  
Linda Wilkerson,  
Dorothy Beach,  
Carole Jordan,  
Carlos Davies,  
Sheryl Bradford,  
Brent Allison,  
Katie Kerr,  
Timothy Davies,  
Thomas Braun,  
Patricia Ferrell,  
Frances Hanna,  
Gregory Schneider,  
Emily Bland,  
Joanna McKee,  
Vicki Parsons,

Becky Bailey,  
Caroline Spears,  
Paige Rollins,  
Deborah Shelton,  
Melanie Butler,  
Michelle Bradshaw,  
Laurie Herbert,  
Ruby Sawyer,  
Danny Barber,  
Christine Gunter,  
Colleen Cannon,  
Carlos Greenberg,  
Jenny Bland,  
Albert Ellis,  
Leah Kinney,  
Todd Clark,  
Clifford Wooten,  
Priscilla Reed,  
Leo Pratt,  
Louise Talley,  
Elisabeth Lewis,  
Ronald Wallace,  
Don Doyle,  
Stephen Wilkinson,  
Bruce Case,  
Esther Pickett,  
Gordon Morrison,  
Christian Yates,  
Jim Burnette,  
Harriet Sloan,  
Monica Wright,  
Judy Barr,  
Erika Boyle,  
Jack Walsh,  
Tonya Gill,  
Max Porter,  
Joe Whitley,  
Kurt Levine,  
Anthony Hutchinson,  
Debbie Sharma,  
Shelley Weeks,  
Stacy Olsen,  
Keith Chandler,  
Tamara Hunt,  
Mary Cochran,  
Hannah Langston,  
Edwin Curtis,  
Allison Norman,  
Clyde Kenney,  
Kyle Bolton,  
Ben Puckett,  
Miriam Berg,  
Ann Chandler,  
Katherine Sutherland,  
Phyllis Byers,  
Marianne Mayo,

Christina Hubbard,  
Annie Lucas,  
Samuel Goodwin,  
Debbie Chappell,  
Patrick Padgett,  
Vickie Stephens,  
Alice Garrett,  
Gerald Walsh,  
Scott Donnelly,  
Frank Fleming,  
Vicki Gould,  
Jeff Hunt,  
Charlie Glover,  
Samantha Conrad,  
William Sherrill,  
Chris Cochran,  
James Cochran,  
Gladys Dorsey,  
Steven Townsend,  
Janice McMahon,  
Charlotte Meyer,  
Victor Capps,  
Shirley Hansen,  
Crystal Martinez,  
Sharon Cooper,  
Maria Avery,  
Zachary Long,  
Carrie Hardin,  
Jennifer Hobbs,  
Jordan Giles,  
Marsha Pollard,  
Ruth Clark,  
John Archer,  
Julie Bloom,  
Kathy Thomson,  
Teresa Kay,  
Kara Simmons,  
Thelma Byers,  
Jonathan Yang,  
Lindsay Norton,  
Jackie Desai,  
Lorraine Jensen,  
Lillian Walton,  
Lynne Stokes,  
Shawn Buckley,  
Louis Haas,  
Glen Baldwin,  
Benjamin Wood,  
Katharine Hall,  
Bonnie Washington,  
Dolores Benton,  
Gloria Henson,  
Alan Boyle,  
Edward Russell,  
Deborah Byrd,  
Nicholas Peele,



Jacqueline Wilkerson,  
Edna Strauss,  
Suzanne Maxwell,  
Vincent Jernigan,  
Mary Stevens,  
Marian Wang,  
Louise Short,  
Raymond Schwarz,  
Luis Everett,  
Florence Wright,  
Billy Wang,  
Milton Sweeney,  
Marjorie Fitzgerald,  
Roger Watts,  
Gretchen Ayers,  
Marianne Fox,  
Gail Stuart,  
Katherine Burns,  
Christopher Myers,  
Norman Hong,  
Philip Kramer,  
Francis Garcia,  
Christopher MacDonald,  
Lawrence Weiss,  
Philip Cunningham,  
James Vogel,  
Sandy Sun,  
Irene Cates,  
Regina Hubbard,  
Meredith Justice,  
Ruth Hardy,  
Victor Choi,  
Gwendolyn Gilliam,  
Gloria Godwin,  
Ernest Harrison,  
Milton Joyner,  
Ken Marshall,  
Heather Conner,  
Robin Bynum,  
Lori Lang,  
Alan McConnell,  
Charlie Carlson,  
Elizabeth Green,  
Kathleen Russell,  
Vincent Grady,  
Tiffany Gardner,  
Jose Dale,  
Edward Prince,  
Walter Blackburn,  
Elisabeth Foster,  
Cindy Glass,  
Calvin Crawford,  
William Dickson,  
Neal McNeill,  
Jimmy Stark,  
Lori Knowles,

Nancy Capps,  
Esther Gold,  
Rick Pridgen,  
Evelyn Hunter,  
Ronnie Perry,  
Joel Han,  
Karl Wrenn,  
Jim Hurley,  
Betty Fleming,  
Kathleen Hodges,  
Dana Kent,  
Fred Garner,  
Earl Osborne,  
Timothy French,  
Rose Greenberg,  
Laurie McKenzie,  
Dean Barker,  
Tom Hurst,  
James Siegel,  
David Roy,  
Bonnie Mann,  
Larry Callahan,  
Michele Hamrick,  
Gayle Cassidy,  
Lorraine Fischer,  
Christopher Stein,  
Jesse Kirkland,  
Ian Hester,  
Renee Clarke,  
Michael Rowland,  
Maria Hewitt,  
Lois Lawson,  
Arnold Creech,  
Vicki Ellis,  
Timothy Hendrix,  
Nina Hood,  
Brian Frederick,  
Marian Griffin,  
Marie Pace,  
Alvin Middleton,  
Lisa Eaton,  
Tamara Curtis,  
Seth McGee,  
Victoria McDaniel,  
Harold Hudson,  
Brad Ballard,  
Megan Bullock,  
Marian George,  
Sandy Raynor,  
Mike Whitehead,  
Charlene Heath,  
Alison MacDonald,  
Diana Crane,  
Neal O'Connor,  
Bill Klein,  
Dean Lutz,

Tonya Ellis,  
Katie Katz,  
Sidney Weber,  
Zachary Black,  
Hannah Mueller,  
Teresa Daniel,  
Bobby Hines,  
Lynda Ball,  
Norman Arthur,  
Jeanette Montgomery,  
Chris Chu,  
Bill Roberson,  
Debra Palmer,  
Amanda Larson,  
Ruby Stout,  
Nicholas Lancaster,  
Claudia Williamson,  
Angela Turner,  
Diana Vincent,  
Kathy Riggs,  
Earl Honeycutt,  
Eileen Pittman,  
Tina Bernstein,  
Troy Browning,  
Heidi Bowles,  
Eva Gill,  
Calvin Godwin,  
Theresa Schroeder,  
Linda Decker,  
Rosemary Choi,  
Christy Stevenson,  
Billy Brooks,  
Harriet Hawley,  
Martha Werner,  
Carl Hinson,  
Joyce Stern,  
Ted Cassidy,  
Brent Moss,  
Frances Capps,  
Vernon Gibbs,  
Brad Ray,  
Sherri Kelly,  
Geoffrey Roy,  
Marlene Bailey,  
Sheila Coley,  
Teresa Joyner,  
Michele Davenport,  
Crystal Morse,  
Samantha Bullock,  
Peggy Corbett,  
Caroline Mayo,  
Meredith Cummings,  
Sam Chandler,  
Bernard Booth,  
Tom Owen,  
Francis Wise,

Carolyn Willis,  
Jill Neal,  
Nicole Nicholson,  
Miriam Medlin,  
Mitchell Carr,  
Vickie Wooten,  
Leigh Conner,  
Constance Reese,  
Eleanor Simmons,  
Juanita Peele,  
Juan Eason,  
Lindsay Blair,  
Marvin Townsend,  
Randy Morton,  
Bernice Douglas,  
Tonya Batchelor,  
Lewis Armstrong,  
Alice Reddy,  
Audrey English,  
Norma Hale,  
Ted Melvin,  
Keith Dunn,  
Lynn Cook,  
Gilbert Adkins,  
Leslie Eason,  
Kevin Raynor,  
Hugh Lane,  
Sam Duke,  
Gerald Humphrey,  
Janet Goldman,  
Frank Sherrill,  
Bobby Sawyer,  
Herbert Doyle,  
Joyce Woodard,  
Allen Massey,  
Edna Hampton,  
Nicholas Garrett,  
June Odom,  
Peter Kenney,  
Harold Hobbs,  
Sandy Ross,  
Lloyd Simpson,  
Ray Hartman,  
Steven Dolan,  
Ruth Rice,  
Arthur Shannon,  
Connie Blackburn,  
Carolyn Nolan,  
Earl Perez,  
Jose Hicks,  
Wesley Field,  
Judy O'Connell,  
Katharine McFarland,  
Edna Cassidy,  
Eddie Fletcher,  
Judy Tuttle,

Dan Stephens,  
Jason Hopkins,  
Jessie Petersen,  
John Dickerson,  
Zachary Haas,  
Harold Norman,  
Lawrence Lim,  
Frederick Parks,  
Tamara Currin,  
Theresa McDonald,  
Howard Kenney,  
Christopher Washington,  
Sidney Terry,  
Stacy Byers,  
Zachary Dougherty,  
Dorothy Shore,  
James Joyce,  
Nathan Hobbs,  
Melissa Sherman,  
Chris Teague,  
Max Hewitt,  
Kay Fletcher,  
Phyllis Bell,  
Jessie Williams,  
Edith Link,  
Ted Hobbs,  
Terry Desai,  
Jennifer Whitley,  
Richard Patrick,  
Anne Greer,  
Leah Parks,  
Ross Puckett,  
Guy Marcus,  
Kathleen Fletcher,  
Julia Dillon,  
Evan Carver,  
Hilda Sherrill,  
Anita Humphrey,  
Jeremy Savage,  
Teresa Dudley,  
Oscar Bernstein,  
Bruce McGuire,  
Gene Daniel,  
Carlos Baker,  
Ross Powers,  
Marion Meadows,  
Gerald Adcock,  
Mitchell Terrell,  
Hazel Merritt,  
Amy Miller,  
Carole White,  
Lee Hardy,  
Clyde McFarland,  
Shirley Kenney,  
Wesley Douglas,  
Ken Hewitt,

Jeanne Powers,  
Tracy Clayton,  
Maxine Ennis,  
Marc Choi,  
Marian Singer,  
Melanie Lucas,  
Kenneth Leonard,  
Harold O'Neill,  
Francis Wood,  
James Small,  
Leslie Cook,  
Colleen Kelley,  
Penny Ross,  
Audrey Garcia,  
Janet Winters,  
Stuart Park,  
Grace House,  
Claire Taylor,  
Edith Briggs,  
Marcus Jensen,  
Philip Peele,  
Jon Barrett,  
Rhonda Pritchard,  
Eva Schmidt,  
Connie Powers,  
Rachel Sutton,  
Kristin Leonard,  
Kimberly Kane,  
Amy Lester,  
Kristin Schroeder,  
Jon Gray,  
Becky Hull,  
Kelly Allen,  
Marshall French,  
Marian Solomon,  
Elsie Barton,  
Douglas Ross,  
Melinda Proctor,  
Samantha Hardin,  
Scott Golden,  
Terry Barton,  
Miriam Wong,  
Jill Kent,  
Malcolm Chan,  
Bradley Duke,  
Catherine Summers,  
Patrick Archer,  
Alvin Frederick,  
Gary Scarborough,  
Shelley Dunn,  
Billy Carroll,  
Richard Harris,  
Gayle Stanley,  
Greg Berger,  
Paige Dudley,  
George Mathews,

Sylvia Hsu,  
Cameron Bowers,  
Allen Randall,  
Nelson Medlin,  
Jeff Dodson,  
Tony Fletcher,  
Ross Hawkins,  
Marcus Howe,  
Sidney Frye,  
Charlene Burnette,  
Emma Day,  
Sean Snow,  
Amy Peters,  
Bryan Weiss,  
Ronald Brandon,  
Ronnie Myers,  
Aaron McKenzie,  
Sam Blum,  
Robyn Dickinson,  
Claudia Hill,  
Connie Sellers,  
Anthony Buckley,  
Natalie McKinney,  
Crystal Kramer,  
Maxine Holden,  
Ken Ritchie,  
Stacy Floyd,  
Glenn Phelps,  
Juanita Lanier,  
Roy Gentry,  
Karen Noble,  
Tracy Sparks,  
James Kang,  
Ruth Bass,  
Adam Carroll,  
Annie Lim,  
Howard French,  
Andrew Rowland,  
Terry Schultz,  
Russell Park,  
Bryan Kennedy,  
Jessica Friedman,  
Glenda Parrish,  
Raymond Crane,  
Leah McCoy,  
Joel Blanchard,  
Veronica Gates,  
Ronnie Boone,  
Sharon Baxter,  
Dwight Arnold,  
Marcus Moran,  
Becky English,  
Bruce Hoyle,  
Carla Ward,  
Priscilla George,  
Ralph Tate,

Laurence Benson,  
Joe Lloyd,  
Louis Langley,  
Dean Hoyle,  
James Burnette,  
Vivian Albright,  
Erin Austin,  
Wendy Poe,  
Bernice Powell,  
Kevin Phillips,  
Pauline Katz,  
Nina Pratt,  
Lori Ritchie,  
Ann Braswell,  
Tony Weeks,  
Edgar Branch,  
Elizabeth Hayes,  
Heidi Blake,  
Scott Knowles,  
Mary Hancock,  
Dale Gorman,  
Evan Singer,  
Brooke Reid,  
Arthur McCarthy,  
Connie Conrad,  
Jane Spivey,  
Renee McNamara,  
Hannah Buchanan,  
Arlene Armstrong,  
Jordan Perkins,  
Nancy Crane,  
Nathan Callahan,  
Florence Rosenberg,  
Louis Sharp,  
Donna Faulkner,  
Heather Huff,  
Joel Woodard,  
Jane Case,  
Emma Kearney,  
Tony McDowell,  
Kelly Swanson,  
Annette Hoyle,  
Troy Monroe,  
Elisabeth Feldman,  
Peter Starr,  
Benjamin Quinn,  
Connie Roach,  
Debra Kumar,  
Marion Mayer,  
Jimmy Holloway,  
Martin Houston,  
Vernon Brock,  
Lynn Silverman,  
Katie Sharpe,  
Erica Best,  
Ryan Strauss,



Vanessa Walsh,  
Glenda Howard,  
Matthew Hobbs,  
Victor Deal,  
Brenda Hodge,  
Laura Griffin,  
Rita Keller,  
Leroy Melvin,  
Leonard Greene,  
Laurie McNeill,  
Sidney Schultz,  
Marshall White,  
Dan Richmond,  
April Gardner,  
Annette Horner,  
Jeanette Barbee,  
Diana Rivera,  
Jenny Beasley,  
Kim Russell,  
Yvonne Swain,  
Kevin Beatty,  
Carlos Block,  
Tony Byrd,  
Gwendolyn Sweeney,  
Erik Christian,  
Robertta Hood,  
Leroy Michael,  
Vernon Hansen,  
Bradley Dougherty,  
Katie Kelly,  
Tonya Bridges,  
Sharon Simpson,  
Vanessa Meadows,  
Kathryn Foley,  
Randall Ivey,  
Audrey West,  
Cindy McLamb,  
Gary Saunders,  
Tara Parks,  
Alvin McKenna,  
Julie Lindsey,  
Tina Flowers,  
Angela Jernigan,  
Tom Fitzgerald,  
Annie Knowles,  
Albert Wiley,  
Theodore Gould,  
Franklin Vick,  
...]

---

---

## HTTPS Requests

```
In [ ]: pip install requests
```

```
In [210... import requests
```

```
In [211... response = requests.get(r"http://127.0.0.1:5000/tasks")  
response
```

```
Out[211... <Response [200]>
```

```
In [214... response.text
```

```
Out[214... '{\n  "TaskNo": [\n      1,\n      2,\n      3\n  ],\n  "Task": [\n    "Flask Project",\n    "Meeting at 3",\n    "Python Session "\n  ],\n  "Created_date": [\n    "2023-09-15 10:00:25.116253",\n    "2023-09-15 13:49:46.580811",\n    "2024-11-28 14:45:35.368632"\n  ],\n  "Due_date": [\n    "2023-09-16 00:00:00",\n    "2023-09-17 00:00:00",\n    "2024-11-28 00:00:00"\n  ],\n  "Status": [\n    "Complete",\n    "In-Progress",\n    "In-Progress"\n  ]\n}'
```

```
In [215... response.json()
```

```
Out[215... {'TaskNo': [1, 2, 3],  
  'Task': ['Flask Project', 'Meeting at 3', 'Python Session '],  
  'Created_date': ['2023-09-15 10:00:25.116253',  
    '2023-09-15 13:49:46.580811',  
    '2024-11-28 14:45:35.368632'],  
  'Due_date': ['2023-09-16 00:00:00',  
    '2023-09-17 00:00:00',  
    '2024-11-28 00:00:00'],  
  'Status': ['Complete', 'In-Progress', 'In-Progress']}
```

```
In [217... requests.get(r"http://127.0.0.1:5000/tasks1").json()
```

```
Out[217... [{ 'TaskNo': 1,  
  'Task': 'Flask Project',  
  'Created_date': '2023-09-15 10:00:25.116253',  
  'Due_date': '2023-09-16 00:00:00',  
  'Status': 'Complete'},  
  { 'TaskNo': 2,  
  'Task': 'Meeting at 3',  
  'Created_date': '2023-09-15 13:49:46.580811',  
  'Due_date': '2023-09-17 00:00:00',  
  'Status': 'In-Progress'},  
  { 'TaskNo': 3,  
  'Task': 'Python Session ',  
  'Created_date': '2024-11-28 14:45:35.368632',  
  'Due_date': '2024-11-28 00:00:00',  
  'Status': 'In-Progress'}]
```

```
In [218... help(requests.get)
```

Help on function get in module requests.api:

```
get(url, params=None, **kwargs)
    Sends a GET request.
```

```
:param url: URL for the new :class:`Request` object.
:param params: (optional) Dictionary, list of tuples or bytes to send
    in the query string for the :class:`Request`.
:param **kwargs: Optional arguments that ``request`` takes.
:return: :class:`Response` object
:rtype: requests.Response
```

---

---

## DataBase Source

```
In [ ]: !pip install SQLAlchemy
        !pip install pymysql
```

- Syntax - dialect+driver://username:password@host:port/database
- Mysql - "mysql+pymysql://root:1234@localhost:3306/onlineshopping"
- Oracle - "oracle+cx\_oracle://s:t@dsn"

## Data Connection

```
In [220... import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from sqlalchemy import create_engine

conn = create_engine('sqlite:///employee.sqlite3').connect()

conn
```

```
Out[220... <sqlalchemy.engine.base.Connection at 0x19c6fd86240>
```

## Select Clause

```
In [224... df = pd.read_sql("Employee", conn) # Create dataframe df by importing data from Em
df.drop(columns = ["index"], inplace= True)
df.head(3)
```

Out[224...

	Name	Salary	Designation	Age
0	Claire	88962	Manager	35
1	Darrin	67659	Team Lead	26
2	Sean	117501	Manager	36

## Insert - Update - Delete

Ex. Creating a new table **Managers** filtering Employee table

In [227...

```
managers = df[df.Designation == "Manager"] # Dataframe - obtained by filtering df
```

In [231...

```
managers.to_sql("Managers", conn, index=False, if_exists="replace")
```

Out[231...

5

In [232...

```
pd.read_sql("Managers", conn)
```

Out[232...

	Name	Salary	Designation	Age
0	Claire	88962	Manager	35
1	Sean	117501	Manager	36
2	Sandra	115116	Manager	41
3	Tracy	109132	Manager	34
4	Matt	83327	Manager	43

In [237...

```
new_data = pd.DataFrame({"Name" : ["Rosie"], "Salary" : [50000], "Designation" : ["Manager"]})  
new_managers = pd.concat((managers, new_data))
```

In [240...

```
new_managers.to_sql("Managers", conn, if_exists="replace", index=False)
```

Out[240...

6

In [241...

```
pd.read_sql("Managers", conn)
```

Out[241...

	Name	Salary	Designation	Age
0	Claire	88962	Manager	35
1	Sean	117501	Manager	36
2	Sandra	115116	Manager	41
3	Tracy	109132	Manager	34
4	Matt	83327	Manager	43
5	Rosie	50000	Manager	45

#### Ex. Modifying data and updating

In [242...

```
new_managers.Salary = new_managers.Salary + 10000
```

In [245...

```
new_managers.to_sql("Managers", conn, if_exists="replace", index=False)
```

Out[245...

6

In [246...

```
pd.read_sql("Managers", conn)
```

Out[246...

	Name	Salary	Designation	Age
0	Claire	98962	Manager	35
1	Sean	127501	Manager	36
2	Sandra	125116	Manager	41
3	Tracy	119132	Manager	34
4	Matt	93327	Manager	43
5	Rosie	60000	Manager	45

In [ ]:

```
conn.execute("Insert into Managers values ('Jack', 90000, 'Manager', 50)")
```

#### Ex. Json to Database using pandas

In [251...

```
json_obj = [{ 'TaskNo': 1,  
              'Task': 'Flask Project',  
              'Created_date': '2023-09-15 10:00:25.116253',  
              'Due_date': '2023-09-16 00:00:00',  
              'Status': 'Complete'},  
            { 'TaskNo': 2,  
              'Task': 'Meeting at 3',  
              'Created_date': '2023-09-15 13:49:46.580811',  
              'Due_date': '2023-09-17 00:00:00',  
              'Status': 'In-Progress'},  
            { 'TaskNo': 3,  
              'Task': 'Python Session ',  
              'Created_date': '2024-11-28 14:45:35.368632',
```

```
'Due_date': '2024-11-28 00:00:00',
'Status': 'In-Progress'}}]

pd.DataFrame(json_obj).to_sql("Tasks", conn, if_exists="replace", index=False)
```

Out[251... 3

In [253... `pd.read_sql("Tasks", conn)`

Out[253...

	TaskNo	Task	Created_date	Due_date	Status
0	1	Flask Project	2023-09-15 10:00:25.116253	2023-09-16 00:00:00	Complete
1	2	Meeting at 3	2023-09-15 13:49:46.580811	2023-09-17 00:00:00	In-Progress
2	3	Python Session	2024-11-28 14:45:35.368632	2024-11-28 00:00:00	In-Progress

### Note -

1. SQLAlchemy + database library is required for database interactions
2. Create engine and connect to database using the sqlalchemy functions
3. Once connection object is ready
  - A. using `pd.read_sql()` or `pd.read_sql_query()` to import data from database into pandas Dataframe object
  - B. Modify/Filter the dataframe object as needed
  - C. using `df.to_sql()` and 'replace' update the table in database (includes - insert, update, delete)
4. Alternative to pandas -
  - A. use `conn.execute()` from sqlalchemy and write the query in str format and excute

## Applications of Python -

1. Data Science (ML, AI, Visualizations)
2. Testing
3. Network Programming
4. Web Programming - Flask or Django
5. Dektop GUI - Tkinter
6. Interact with windows features - pywinauto

In [2]: `print(dir(__builtins__))`

```
['ArithmeticError', 'AssertionError', 'AttributeError', 'BaseException', 'BaseExceptionGroup', 'BlockingIOError', 'BrokenPipeError', 'BufferError', 'BytesWarning', 'ChildProcessError', 'ConnectionAbortedError', 'ConnectionError', 'ConnectionRefusedError', 'ConnectionResetError', 'DeprecationWarning', 'EOFError', 'Ellipsis', 'EncodingWarning', 'EnvironmentError', 'Exception', 'ExceptionGroup', 'False', 'FileExistsError', 'FileNotFoundError', 'FloatingPointError', 'FutureWarning', 'GeneratorExit', 'IOError', 'ImportError', 'ImportWarning', 'IndentationError', 'IndexError', 'InterruptedError', 'IsADirectoryError', 'KeyError', 'KeyboardInterrupt', 'LookupError', 'MemoryError', 'ModuleNotFoundError', 'NameError', 'None', 'NotADirectoryError', 'NotImplemented', 'NotImplementedError', 'OSError', 'OverflowError', 'PendingDeprecationWarning', 'PermissionError', 'ProcessLookupError', 'RecursionError', 'ReferenceError', 'ResourceWarning', 'RuntimeError', 'RuntimeWarning', 'StopAsyncIteration', 'StopIteration', 'SyntaxError', 'SyntaxWarning', 'SystemError', 'SystemExit', 'TabError', 'TimeoutError', 'True', 'TypeError', 'UnboundLocalError', 'UnicodeDecodeError', 'UnicodeEncodeError', 'UnicodeError', 'UnicodeTranslateError', 'UnicodeWarning', 'UserWarning', 'ValueError', 'Warning', 'WindowsError', 'ZeroDivisionError', '__IPYTHON__', '__build_class__', '__debug__', '__doc__', '__import__', '__loader__', '__name__', '__package__', '__spec__', 'abs', 'aiter', 'all', 'anext', 'any', 'ascii', 'bin', 'bool', 'breakpoint', 'bytearray', 'bytes', 'callable', 'chr', 'classmethod', 'compile', 'complex', 'copyright', 'credits', 'delattr', 'dict', 'dir', 'display', 'divmod', 'enumerate', 'eval', 'exec', 'execfile', 'filter', 'float', 'format', 'frozenset', 'get_ipython', 'getattr', 'globals', 'hasattr', 'hash', 'help', 'hex', 'id', 'input', 'int', 'isinstance', 'issubclass', 'iter', 'len', 'license', 'list', 'locals', 'map', 'max', 'memoryview', 'min', 'next', 'object', 'oct', 'open', 'ord', 'pow', 'print', 'property', 'range', 'repr', 'reversed', 'round', 'runfile', 'set', 'setattr', 'slice', 'sorted', 'staticmethod', 'str', 'sum', 'super', 'tuple', 'type', 'vars', 'zip']
```

```
In [3]: import math
        print(dir(math))
```

```
['__doc__', '__loader__', '__name__', '__package__', '__spec__', 'acos', 'acosh', 'asin', 'asinh', 'atan', 'atan2', 'atanh', 'cbrt', 'ceil', 'comb', 'copysign', 'cos', 'cosh', 'degrees', 'dist', 'e', 'erf', 'erfc', 'exp', 'exp2', 'expm1', 'fabs', 'factorial', 'floor', 'fmod', 'frexp', 'fsum', 'gamma', 'gcd', 'hypot', 'inf', 'isclose', 'isfinite', 'isinf', 'isnan', 'isqrt', 'lcm', 'ldexp', 'lgamma', 'log', 'log10', 'log1p', 'log2', 'modf', 'nan', 'nextafter', 'perm', 'pi', 'pow', 'prod', 'radians', 'remainder', 'sin', 'sinh', 'sqrt', 'sumprod', 'tan', 'tanh', 'tau', 'trunc', 'ulp']
```

```
In [4]: help(math.sqrt)
```

Help on built-in function sqrt in module math:

```
sqrt(x, /)
    Return the square root of x.
```

```
In [5]: help(math.pi)
```

Help on float object:

```
class float(object)
|   float(x=0, /)
|
|   Convert a string or number to a floating point number, if possible.
|
|   Methods defined here:
|
|   __abs__(self, /)
|       abs(self)
|
|   __add__(self, value, /)
|       Return self+value.
|
|   __bool__(self, /)
|       True if self else False
|
|   __ceil__(self, /)
|       Return the ceiling as an Integral.
|
|   __divmod__(self, value, /)
|       Return divmod(self, value).
|
|   __eq__(self, value, /)
|       Return self==value.
|
|   __float__(self, /)
|       float(self)
|
|   __floor__(self, /)
|       Return the floor as an Integral.
|
|   __floordiv__(self, value, /)
|       Return self//value.
|
|   __format__(self, format_spec, /)
|       Formats the float according to format_spec.
|
|   __ge__(self, value, /)
|       Return self>=value.
|
|   __getattr__(self, name, /)
|       Return getattr(self, name).
|
|   __getnewargs__(self, /)
|
|   __gt__(self, value, /)
|       Return self>value.
|
|   __hash__(self, /)
|       Return hash(self).
|
|   __int__(self, /)
|       int(self)
```



```

__le__(self, value, /)
    Return self<=value.

__lt__(self, value, /)
    Return self<value.

__mod__(self, value, /)
    Return self%value.

__mul__(self, value, /)
    Return self*value.

__ne__(self, value, /)
    Return self!=value.

__neg__(self, /)
    -self

__pos__(self, /)
    +self

__pow__(self, value, mod=None, /)
    Return pow(self, value, mod).

__radd__(self, value, /)
    Return value+self.

__rdivmod__(self, value, /)
    Return divmod(value, self).

__repr__(self, /)
    Return repr(self).

__rfloordiv__(self, value, /)
    Return value//self.

__rmod__(self, value, /)
    Return value%self.

__rmul__(self, value, /)
    Return value*self.

__round__(self, ndigits=None, /)
    Return the Integral closest to x, rounding half toward even.

    When an argument is passed, work like built-in round(x, ndigits).

__rpow__(self, value, mod=None, /)
    Return pow(value, self, mod).

__rsub__(self, value, /)
    Return value-self.

__rtruediv__(self, value, /)
    Return value/self.

```

```

|  __sub__(self, value, /)
|      Return self-value.
|
|  __truediv__(self, value, /)
|      Return self/value.
|
|  __trunc__(self, /)
|      Return the Integral closest to x between 0 and x.
|
|  as_integer_ratio(self, /)
|      Return a pair of integers, whose ratio is exactly equal to the original float.
|
|      The ratio is in lowest terms and has a positive denominator. Raise
|      OverflowError on infinities and a ValueError on NaNs.
|
|      >>> (10.0).as_integer_ratio()
|      (10, 1)
|      >>> (0.0).as_integer_ratio()
|      (0, 1)
|      >>> (-.25).as_integer_ratio()
|      (-1, 4)
|
|  conjugate(self, /)
|      Return self, the complex conjugate of any float.
|
|  hex(self, /)
|      Return a hexadecimal representation of a floating-point number.
|
|      >>> (-0.1).hex()
|      '-0x1.999999999999ap-4'
|      >>> 3.14159.hex()
|      '0x1.921f9f01b866ep+1'
|
|  is_integer(self, /)
|      Return True if the float is an integer.
|
|  -----
|  Class methods defined here:
|
|  __getformat__(typestr, /)
|      You probably don't want to use this function.
|
|      typestr
|          Must be 'double' or 'float'.
|
|      It exists mainly to be used in Python's test suite.
|
|      This function returns whichever of 'unknown', 'IEEE, big-endian' or 'IEEE,
|      little-endian' best describes the format of floating point numbers used by the
|      C type named by typestr.
|
|  fromhex(string, /)
|      Create a floating-point number from a hexadecimal string.

```

```
>>> float.fromhex('0x1.ffffp10')
2047.984375
>>> float.fromhex('-0x1p-1074')
-5e-324
```

-----  
Static methods defined here:

`__new__(*args, **kwargs)`

Create and return a new object. See `help(type)` for accurate signature.

-----  
Data descriptors defined here:

`imag`

the imaginary part of a complex number

`real`

the real part of a complex number

---

---