

# Beginner's Python Cheat Sheet

## Variables and Strings

Variables are used to store values. A string is a series of characters, surrounded by single or double quotes.

### Hello world

```
print("Hello world!")
```

### Hello world with a variable

```
msg = "Hello world!"  
print(msg)
```

### Concatenation (combining strings)

```
first_name = 'albert'  
last_name = 'einstein'  
full_name = first_name + ' ' + last_name  
print(full_name)
```

## Lists

A list stores a series of items in a particular order. You access items using an index, or within a loop.

### Make a list

```
bikes = ['trek', 'redline', 'giant']
```

### Get the first item in a list

```
first_bike = bikes[0]
```

### Get the last item in a list

```
last_bike = bikes[-1]
```

### Looping through a list

```
for bike in bikes:  
    print(bike)
```

### Adding items to a list

```
bikes = []  
bikes.append('trek')  
bikes.append('redline')  
bikes.append('giant')
```

### Making numerical lists

```
squares = []  
for x in range(1, 11):  
    squares.append(x**2)
```

## Lists (cont.)

### List comprehensions

```
squares = [x**2 for x in range(1, 11)]
```

### Slicing a list

```
finishers = ['sam', 'bob', 'ada', 'bea']  
first_two = finishers[:2]
```

### Copying a list

```
copy_of_bikes = bikes[:]
```

## Tuples

Tuples are similar to lists, but the items in a tuple can't be modified.

### Making a tuple

```
dimensions = (1920, 1080)
```

## If statements

If statements are used to test for particular conditions and respond appropriately.

### Conditional tests

equals	x == 42
not equal	x != 42
greater than	x > 42
or equal to	x >= 42
less than	x < 42
or equal to	x <= 42

### Conditional test with lists

```
'trek' in bikes  
'surly' not in bikes
```

### Assigning boolean values

```
game_active = True  
can_edit = False
```

### A simple if test

```
if age >= 18:  
    print("You can vote!")
```

### If-elif-else statements

```
if age < 4:  
    ticket_price = 0  
elif age < 18:  
    ticket_price = 10  
else:  
    ticket_price = 15
```

## Dictionaries

Dictionaries store connections between pieces of information. Each item in a dictionary is a key-value pair.

### A simple dictionary

```
alien = {'color': 'green', 'points': 5}
```

### Accessing a value

```
print("The alien's color is " + alien['color'])
```

### Adding a new key-value pair

```
alien['x_position'] = 0
```

### Looping through all key-value pairs

```
fav_numbers = {'eric': 17, 'ever': 4}  
for name, number in fav_numbers.items():  
    print(name + ' loves ' + str(number))
```

### Looping through all keys

```
fav_numbers = {'eric': 17, 'ever': 4}  
for name in fav_numbers.keys():  
    print(name + ' loves a number')
```

### Looping through all the values

```
fav_numbers = {'eric': 17, 'ever': 4}  
for number in fav_numbers.values():  
    print(str(number) + ' is a favorite')
```

## User input

Your programs can prompt the user for input. All input is stored as a string.

### Prompting for a value

```
name = input("What's your name? ")  
print("Hello, " + name + "!")
```

### Prompting for numerical input

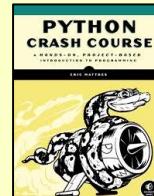
```
age = input("How old are you? ")  
age = int(age)
```

```
pi = input("What's the value of pi? ")  
pi = float(pi)
```

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## While loops

A *while loop* repeats a block of code as long as a certain condition is true.

### A simple while loop

```
current_value = 1
while current_value <= 5:
    print(current_value)
    current_value += 1
```

### Letting the user choose when to quit

```
msg = ''
while msg != 'quit':
    msg = input("What's your message? ")
    print(msg)
```

## Functions

Functions are named blocks of code, designed to do one specific job. Information passed to a function is called an argument, and information received by a function is called a parameter.

### A simple function

```
def greet_user():
    """Display a simple greeting."""
    print("Hello!")

greet_user()
```

### Passing an argument

```
def greet_user(username):
    """Display a personalized greeting."""
    print("Hello, " + username + "!")

greet_user('jesse')
```

### Default values for parameters

```
def make_pizza(topping='bacon'):
    """Make a single-topping pizza."""
    print("Have a " + topping + " pizza!")

make_pizza()
make_pizza('pepperoni')
```

### Returning a value

```
def add_numbers(x, y):
    """Add two numbers and return the sum."""
    return x + y

sum = add_numbers(3, 5)
print(sum)
```

## Classes

A *class* defines the behavior of an object and the kind of information an object can store. The information in a class is stored in attributes, and functions that belong to a class are called methods. A child class inherits the attributes and methods from its parent class.

### Creating a dog class

```
class Dog():
    """Represent a dog."""

    def __init__(self, name):
        """Initialize dog object."""
        self.name = name

    def sit(self):
        """Simulate sitting."""
        print(self.name + " is sitting.")

my_dog = Dog('Peso')

print(my_dog.name + " is a great dog!")
my_dog.sit()
```

### Inheritance

```
class SARDog(Dog):
    """Represent a search dog."""

    def __init__(self, name):
        """Initialize the sardog."""
        super().__init__(name)

    def search(self):
        """Simulate searching."""
        print(self.name + " is searching.")

my_dog = SARDog('Willie')

print(my_dog.name + " is a search dog.")
my_dog.sit()
my_dog.search()
```

## Infinite Skills

If you had infinite programming skills, what would you build?

As you're learning to program, it's helpful to think about the real-world projects you'd like to create. It's a good habit to keep an "ideas" notebook that you can refer to whenever you want to start a new project. If you haven't done so already, take a few minutes and describe three projects you'd like to create.

## Working with files

Your programs can read from files and write to files. Files are opened in read mode ('r') by default, but can also be opened in write mode ('w') and append mode ('a').

### Reading a file and storing its lines

```
filename = 'siddhartha.txt'
with open(filename) as file_object:
    lines = file_object.readlines()

for line in lines:
    print(line)
```

### Writing to a file

```
filename = 'journal.txt'
with open(filename, 'w') as file_object:
    file_object.write("I love programming.")
```

### Appending to a file

```
filename = 'journal.txt'
with open(filename, 'a') as file_object:
    file_object.write("\nI love making games.")
```

## Exceptions

Exceptions help you respond appropriately to errors that are likely to occur. You place code that might cause an error in the try block. Code that should run in response to an error goes in the except block. Code that should run only if the try block was successful goes in the else block.

### Catching an exception

```
prompt = "How many tickets do you need? "
num_tickets = input(prompt)

try:
    num_tickets = int(num_tickets)
except ValueError:
    print("Please try again.")
else:
    print("Your tickets are printing.")
```

## Zen of Python

Simple is better than complex

If you have a choice between a simple and a complex solution, and both work, use the simple solution. Your code will be easier to maintain, and it will be easier for you and others to build on that code later on.

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# Beginner's Python Cheat Sheet - Lists

## What are lists?

A list stores a series of items in a particular order. Lists allow you to store sets of information in one place, whether you have just a few items or millions of items. Lists are one of Python's most powerful features readily accessible to new programmers, and they tie together many important concepts in programming.

## Defining a list

Use square brackets to define a list, and use commas to separate individual items in the list. Use plural names for lists, to make your code easier to read.

## Making a list

```
users = ['val', 'bob', 'mia', 'ron', 'ned']
```

## Accessing elements

Individual elements in a list are accessed according to their position, called the index. The index of the first element is 0, the index of the second element is 1, and so forth. Negative indices refer to items at the end of the list. To get a particular element, write the name of the list and then the index of the element in square brackets.

## Getting the first element

```
first_user = users[0]
```

## Getting the second element

```
second_user = users[1]
```

## Getting the last element

```
newest_user = users[-1]
```

## Modifying individual items

Once you've defined a list, you can change individual elements in the list. You do this by referring to the index of the item you want to modify.

## Changing an element

```
users[0] = 'valerie'  
users[-2] = 'ronald'
```

## Adding elements

You can add elements to the end of a list, or you can insert them wherever you like in a list.

### Adding an element to the end of the list

```
users.append('amy')
```

### Starting with an empty list

```
users = []  
users.append('val')  
users.append('bob')  
users.append('mia')
```

### Inserting elements at a particular position

```
users.insert(0, 'joe')  
users.insert(3, 'bea')
```

## Removing elements

You can remove elements by their position in a list, or by the value of the item. If you remove an item by its value, Python removes only the first item that has that value.

### Deleting an element by its position

```
del users[-1]
```

### Removing an item by its value

```
users.remove('mia')
```

## Popping elements

If you want to work with an element that you're removing from the list, you can "pop" the element. If you think of the list as a stack of items, pop() takes an item off the top of the stack. By default pop() returns the last element in the list, but you can also pop elements from any position in the list.

### Pop the last item from a list

```
most_recent_user = users.pop()  
print(most_recent_user)
```

### Pop the first item in a list

```
first_user = users.pop(0)  
print(first_user)
```

## List length

The len() function returns the number of items in a list.

### Find the length of a list

```
num_users = len(users)  
print("We have " + str(num_users) + " users.")
```

## Sorting a list

The sort() method changes the order of a list permanently. The sorted() function returns a copy of the list, leaving the original list unchanged. You can sort the items in a list in alphabetical order, or reverse alphabetical order. You can also reverse the original order of the list. Keep in mind that lowercase and uppercase letters may affect the sort order.

### Sorting a list permanently

```
users.sort()
```

### Sorting a list permanently in reverse alphabetical order

```
users.sort(reverse=True)
```

### Sorting a list temporarily

```
print(sorted(users))  
print(sorted(users, reverse=True))
```

### Reversing the order of a list

```
users.reverse()
```

## Looping through a list

Lists can contain millions of items, so Python provides an efficient way to loop through all the items in a list. When you set up a loop, Python pulls each item from the list one at a time and stores it in a temporary variable, which you provide a name for. This name should be the singular version of the list name.

The indented block of code makes up the body of the loop, where you can work with each individual item. Any lines that are not indented run after the loop is completed.

### Printing all items in a list

```
for user in users:  
    print(user)
```

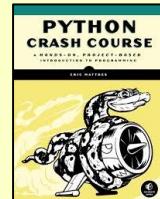
### Printing a message for each item, and a separate message afterwards

```
for user in users:  
    print("Welcome, " + user + "!")  
  
print("Welcome, we're glad to see you all!")
```

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## The range() function

You can use the `range()` function to work with a set of numbers efficiently. The `range()` function starts at 0 by default, and stops one number below the number passed to it. You can use the `list()` function to efficiently generate a large list of numbers.

### Printing the numbers 0 to 1000

```
for number in range(1001):
    print(number)
```

### Printing the numbers 1 to 1000

```
for number in range(1, 1001):
    print(number)
```

### Making a list of numbers from 1 to a million

```
numbers = list(range(1, 1000001))
```

## Simple statistics

There are a number of simple statistics you can run on a list containing numerical data.

### Finding the minimum value in a list

```
ages = [93, 99, 66, 17, 85, 1, 35, 82, 2, 77]
youngest = min(ages)
```

### Finding the maximum value

```
ages = [93, 99, 66, 17, 85, 1, 35, 82, 2, 77]
oldest = max(ages)
```

### Finding the sum of all values

```
ages = [93, 99, 66, 17, 85, 1, 35, 82, 2, 77]
total_years = sum(ages)
```

## Slicing a list

You can work with any set of elements from a list. A portion of a list is called a slice. To slice a list start with the index of the first item you want, then add a colon and the index after the last item you want. Leave off the first index to start at the beginning of the list, and leave off the last index to slice through the end of the list.

### Getting the first three items

```
finishers = ['kai', 'abe', 'ada', 'gus', 'zoe']
first_three = finishers[:3]
```

### Getting the middle three items

```
middle_three = finishers[1:4]
```

### Getting the last three items

```
last_three = finishers[-3:]
```

## Copying a list

To copy a list make a slice that starts at the first item and ends at the last item. If you try to copy a list without using this approach, whatever you do to the copied list will affect the original list as well.

### Making a copy of a list

```
finishers = ['kai', 'abe', 'ada', 'gus', 'zoe']
copy_of_finishers = finishers[:]
```

## List comprehensions

You can use a loop to generate a list based on a range of numbers or on another list. This is a common operation, so Python offers a more efficient way to do it. List comprehensions may look complicated at first; if so, use the for loop approach until you're ready to start using comprehensions.

To write a comprehension, define an expression for the values you want to store in the list. Then write a for loop to generate input values needed to make the list.

### Using a loop to generate a list of square numbers

```
squares = []
for x in range(1, 11):
    square = x**2
    squares.append(square)
```

### Using a comprehension to generate a list of square numbers

```
squares = [x**2 for x in range(1, 11)]
```

### Using a loop to convert a list of names to upper case

```
names = ['kai', 'abe', 'ada', 'gus', 'zoe']

upper_names = []
for name in names:
    upper_names.append(name.upper())
```

### Using a comprehension to convert a list of names to upper case

```
names = ['kai', 'abe', 'ada', 'gus', 'zoe']

upper_names = [name.upper() for name in names]
```

## Styling your code

### Readability counts

- Use four spaces per indentation level.
- Keep your lines to 79 characters or fewer.
- Use single blank lines to group parts of your program visually.

## Tuples

A tuple is like a list, except you can't change the values in a tuple once it's defined. Tuples are good for storing information that shouldn't be changed throughout the life of a program. Tuples are designated by parentheses instead of square brackets. (You can overwrite an entire tuple, but you can't change the individual elements in a tuple.)

### Defining a tuple

```
dimensions = (800, 600)
```

### Looping through a tuple

```
for dimension in dimensions:
    print(dimension)
```

### Overwriting a tuple

```
dimensions = (800, 600)
print(dimensions)
```

```
dimensions = (1200, 900)
```

## Visualizing your code

When you're first learning about data structures such as lists, it helps to visualize how Python is working with the information in your program. [pythontutor.com](http://pythontutor.com) is a great tool for seeing how Python keeps track of the information in a list. Try running the following code on [pythontutor.com](http://pythontutor.com), and then run your own code.

### Build a list and print the items in the list

```
dogs = []
dogs.append('willie')
dogs.append('hootz')
dogs.append('peso')
dogs.append('goblin')

for dog in dogs:
    print("Hello " + dog + "!")
print("I love these dogs!")
```

```
print("\nThese were my first two dogs:")
old_dogs = dogs[:2]
for old_dog in old_dogs:
    print(old_dog)
```

```
del dogs[0]
dogs.remove('peso')
print(dogs)
```

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# Beginner's Python Cheat Sheet — Dictionaries

## What are dictionaries?

Python's dictionaries allow you to connect pieces of related information. Each piece of information in a dictionary is stored as a key-value pair. When you provide a key, Python returns the value associated with that key. You can loop through all the key-value pairs, all the keys, or all the values.

## Defining a dictionary

Use curly braces to define a dictionary. Use colons to connect keys and values, and use commas to separate individual key-value pairs.

## Making a dictionary

```
alien_0 = {'color': 'green', 'points': 5}
```

## Accessing values

To access the value associated with an individual key give the name of the dictionary and then place the key in a set of square brackets. If the key you're asking for is not in the dictionary, an error will occur.

You can also use the `get()` method, which returns `None` instead of an error if the key doesn't exist. You can also specify a default value to use if the key is not in the dictionary.

## Getting the value associated with a key

```
alien_0 = {'color': 'green', 'points': 5}

print(alien_0['color'])
print(alien_0['points'])
```

## Getting the value with `get()`

```
alien_0 = {'color': 'green'}

alien_color = alien_0.get('color')
alien_points = alien_0.get('points', 0)

print(alien_color)
print(alien_points)
```

## Adding new key-value pairs

You can store as many key-value pairs as you want in a dictionary, until your computer runs out of memory. To add a new key-value pair to an existing dictionary give the name of the dictionary and the new key in square brackets, and set it equal to the new value.

This also allows you to start with an empty dictionary and add key-value pairs as they become relevant.

## Adding a key-value pair

```
alien_0 = {'color': 'green', 'points': 5}

alien_0['x'] = 0
alien_0['y'] = 25
alien_0['speed'] = 1.5
```

## Adding to an empty dictionary

```
alien_0 = {}
alien_0['color'] = 'green'
alien_0['points'] = 5
```

## Modifying values

You can modify the value associated with any key in a dictionary. To do so give the name of the dictionary and enclose the key in square brackets, then provide the new value for that key.

## Modifying values in a dictionary

```
alien_0 = {'color': 'green', 'points': 5}
print(alien_0)
```

```
# Change the alien's color and point value.
alien_0['color'] = 'yellow'
alien_0['points'] = 10
print(alien_0)
```

## Removing key-value pairs

You can remove any key-value pair you want from a dictionary. To do so use the `del` keyword and the dictionary name, followed by the key in square brackets. This will delete the key and its associated value.

## Deleting a key-value pair

```
alien_0 = {'color': 'green', 'points': 5}
print(alien_0)

del alien_0['points']
print(alien_0)
```

## Visualizing dictionaries

Try running some of these examples on [pythontutor.com](http://pythontutor.com).

## Looping through a dictionary

You can loop through a dictionary in three ways: you can loop through all the key-value pairs, all the keys, or all the values.

A dictionary only tracks the connections between keys and values; it doesn't track the order of items in the dictionary. If you want to process the information in order, you can sort the keys in your loop.

## Looping through all key-value pairs

```
# Store people's favorite languages.
fav_languages = {
    'jen': 'python',
    'sarah': 'c',
    'edward': 'ruby',
    'phil': 'python',
}
```

```
# Show each person's favorite language.
for name, language in fav_languages.items():
    print(name + ": " + language)
```

## Looping through all the keys

```
# Show everyone who's taken the survey.
for name in fav_languages.keys():
    print(name)
```

## Looping through all the values

```
# Show all the languages that have been chosen.
for language in fav_languages.values():
    print(language)
```

## Looping through all the keys in order

```
# Show each person's favorite language,
# in order by the person's name.
for name in sorted(fav_languages.keys()):
    print(name + ": " + language)
```

## Dictionary length

You can find the number of key-value pairs in a dictionary.

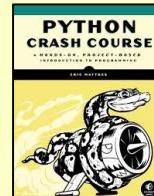
## Finding a dictionary's length

```
num_responses = len(fav_languages)
```

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## Nesting — A list of dictionaries

*It's sometimes useful to store a set of dictionaries in a list; this is called nesting.*

### Storing dictionaries in a list

```
# Start with an empty list.  
users = []  
  
# Make a new user, and add them to the list.  
new_user = {  
    'last': 'fermi',  
    'first': 'enrico',  
    'username': 'efermi',  
}  
users.append(new_user)  
  
# Make another new user, and add them as well.  
new_user = {  
    'last': 'curie',  
    'first': 'marie',  
    'username': 'mcurie',  
}  
users.append(new_user)  
  
# Show all information about each user.  
for user_dict in users:  
    for k, v in user_dict.items():  
        print(k + ":" + v)  
    print("\n")
```

You can also define a list of dictionaries directly, without using `append()`:

```
# Define a list of users, where each user  
#   is represented by a dictionary.  
users = [  
    {  
        'last': 'fermi',  
        'first': 'enrico',  
        'username': 'efermi',  
    },  
    {  
        'last': 'curie',  
        'first': 'marie',  
        'username': 'mcurie',  
    },  
]  
  
# Show all information about each user.  
for user_dict in users:  
    for k, v in user_dict.items():  
        print(k + ":" + v)  
    print("\n")
```

## Nesting — Lists in a dictionary

*Storing a list inside a dictionary allows you to associate more than one value with each key.*

### Storing lists in a dictionary

```
# Store multiple languages for each person.  
fav_languages = {  
    'jen': ['python', 'ruby'],  
    'sarah': ['c'],  
    'edward': ['ruby', 'go'],  
    'phil': ['python', 'haskell'],  
}  
  
# Show all responses for each person.  
for name, langs in fav_languages.items():  
    print(name + ":")  
    for lang in langs:  
        print("- " + lang)
```

## Nesting — A dictionary of dictionaries

*You can store a dictionary inside another dictionary. In this case each value associated with a key is itself a dictionary.*

### Storing dictionaries in a dictionary

```
users = {  
    'aeinstein': {  
        'first': 'albert',  
        'last': 'einstein',  
        'location': 'princeton',  
    },  
    'mcurie': {  
        'first': 'marie',  
        'last': 'curie',  
        'location': 'paris',  
    },  
}  
  
for username, user_dict in users.items():  
    print("\nUsername: " + username)  
    full_name = user_dict['first'] + " "  
    full_name += user_dict['last']  
    location = user_dict['location']  
  
    print("\tFull name: " + full_name.title())  
    print("\tLocation: " + location.title())
```

## Levels of nesting

*Nesting is extremely useful in certain situations. However, be aware of making your code overly complex. If you're nesting items much deeper than what you see here there are probably simpler ways of managing your data, such as using classes.*

## Using an OrderedDict

*Standard Python dictionaries don't keep track of the order in which keys and values are added; they only preserve the association between each key and its value. If you want to preserve the order in which keys and values are added, use an `OrderedDict`.*

### Preserving the order of keys and values

```
from collections import OrderedDict  
  
# Store each person's languages, keeping  
#   track of who responded first.  
fav_languages = OrderedDict()  
  
fav_languages['jen'] = ['python', 'ruby']  
fav_languages['sarah'] = ['c']  
fav_languages['edward'] = ['ruby', 'go']  
fav_languages['phil'] = ['python', 'haskell']  
  
# Display the results, in the same order they  
#   were entered.  
for name, langs in fav_languages.items():  
    print(name + ":")  
    for lang in langs:  
        print("- " + lang)
```

## Generating a million dictionaries

*You can use a loop to generate a large number of dictionaries efficiently, if all the dictionaries start out with similar data.*

### A million aliens

```
aliens = []  
  
# Make a million green aliens, worth 5 points  
#   each. Have them all start in one row.  
for alien_num in range(1000000):  
    new_alien = {}  
    new_alien['color'] = 'green'  
    new_alien['points'] = 5  
    new_alien['x'] = 20 * alien_num  
    new_alien['y'] = 0  
    aliens.append(new_alien)  
  
# Prove the list contains a million aliens.  
num.aliens = len(aliens)
```

```
print("Number of aliens created:")  
print(num.aliens)
```

More cheat sheets available at  
[ehmatthes.github.io/pcc/](https://ehmatthes.github.io/pcc/)

# Beginner's Python Cheat Sheet — If Statements and While Loops

## What are if statements? What are while loops?

If statements allow you to examine the current state of a program and respond appropriately to that state. You can write a simple if statement that checks one condition, or you can create a complex series of if statements that identify the exact conditions you're looking for.

While loops run as long as certain conditions remain true. You can use while loops to let your programs run as long as your users want them to.

## Conditional Tests

A conditional test is an expression that can be evaluated as True or False. Python uses the values True and False to decide whether the code in an if statement should be executed.

### Checking for equality

A single equal sign assigns a value to a variable. A double equal sign (==) checks whether two values are equal.

```
>>> car = 'bmw'  
>>> car == 'bmw'  
True  
>>> car = 'audi'  
>>> car == 'bmw'  
False
```

### Ignoring case when making a comparison

```
>>> car = 'Audi'  
>>> car.lower() == 'audi'  
True
```

### Checking for inequality

```
>>> topping = 'mushrooms'  
>>> topping != 'anchovies'  
True
```

## Numerical comparisons

Testing numerical values is similar to testing string values.

### Testing equality and inequality

```
>>> age = 18  
>>> age == 18  
True  
>>> age != 18  
False
```

### Comparison operators

```
>>> age = 19  
>>> age < 21  
True  
>>> age <= 21  
True  
>>> age > 21  
False  
>>> age >= 21  
False
```

## Checking multiple conditions

You can check multiple conditions at the same time. The and operator returns True if all the conditions listed are True. The or operator returns True if any condition is True.

### Using and to check multiple conditions

```
>>> age_0 = 22  
>>> age_1 = 18  
>>> age_0 >= 21 and age_1 >= 21  
False  
>>> age_1 = 23  
>>> age_0 >= 21 and age_1 >= 21  
True
```

### Using or to check multiple conditions

```
>>> age_0 = 22  
>>> age_1 = 18  
>>> age_0 >= 21 or age_1 >= 21  
True  
>>> age_0 = 18  
>>> age_0 >= 21 or age_1 >= 21  
False
```

## Boolean values

A boolean value is either True or False. Variables with boolean values are often used to keep track of certain conditions within a program.

### Simple boolean values

```
game_active = True  
can_edit = False
```

## If statements

Several kinds of if statements exist. Your choice of which to use depends on the number of conditions you need to test. You can have as many elif blocks as you need, and the else block is always optional.

### Simple if statement

```
age = 19
```

```
if age >= 18:  
    print("You're old enough to vote!")
```

### If-else statements

```
age = 17
```

```
if age >= 18:  
    print("You're old enough to vote!")  
else:  
    print("You can't vote yet.")
```

### The if-elif-else chain

```
age = 12
```

```
if age < 4:  
    price = 0  
elif age < 18:  
    price = 5  
else:  
    price = 10  
  
print("Your cost is $" + str(price) + ".")
```

## Conditional tests with lists

You can easily test whether a certain value is in a list. You can also test whether a list is empty before trying to loop through the list.

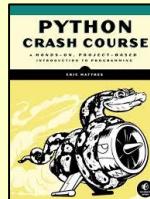
### Testing if a value is in a list

```
>>> players = ['al', 'bea', 'cyn', 'dale']  
>>> 'al' in players  
True  
>>> 'eric' in players  
False
```

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## Conditional tests with lists (cont.)

### Testing if a value is not in a list

```
banned_users = ['ann', 'chad', 'dee']
user = 'erin'

if user not in banned_users:
    print("You can play!")
```

### Checking if a list is empty

```
players = []

if players:
    for player in players:
        print("Player: " + player.title())
else:
    print("We have no players yet!")
```

## Accepting input

You can allow your users to enter input using the `input()` statement. In Python 3, all input is stored as a string.

### Simple input

```
name = input("What's your name? ")
print("Hello, " + name + ".")
```

### Accepting numerical input

```
age = input("How old are you? ")
age = int(age)

if age >= 18:
    print("\nYou can vote!")
else:
    print("\nYou can't vote yet.")
```

### Accepting input in Python 2.7

Use `raw_input()` in Python 2.7. This function interprets all input as a string, just as `input()` does in Python 3.

```
name = raw_input("What's your name? ")
print("Hello, " + name + ".")
```

## While loops

A while loop repeats a block of code as long as a condition is True.

### Counting to 5

```
current_number = 1

while current_number <= 5:
    print(current_number)
    current_number += 1
```

## While loops (cont.)

### Letting the user choose when to quit

```
prompt = "\nTell me something, and I'll "
prompt += "repeat it back to you."
prompt += "\nEnter 'quit' to end the program.

message = ""
while message != 'quit':
    message = input(prompt)

    if message != 'quit':
        print(message)
```

### Using a flag

```
prompt = "\nTell me something, and I'll "
prompt += "repeat it back to you."
prompt += "\nEnter 'quit' to end the program.

active = True
while active:
    message = input(prompt)
```

```
    if message == 'quit':
        active = False
    else:
        print(message)
```

### Using break to exit a loop

```
prompt = "\nWhat cities have you visited?"
prompt += "\nEnter 'quit' when you're done.

while True:
    city = input(prompt)

    if city == 'quit':
        break
    else:
        print("I've been to " + city + "!")
```

## Accepting input with Sublime Text

Sublime Text doesn't run programs that prompt the user for input. You can use Sublime Text to write programs that prompt for input, but you'll need to run these programs from a terminal.

## Breaking out of loops

You can use the `break` statement and the `continue` statement with any of Python's loops. For example you can use `break` to quit a for loop that's working through a list or a dictionary. You can use `continue` to skip over certain items when looping through a list or dictionary as well.

## While loops (cont.)

### Using continue in a loop

```
banned_users = ['eve', 'fred', 'gary', 'helen']

prompt = "\nAdd a player to your team."
prompt += "\nEnter 'quit' when you're done.

players = []
while True:
    player = input(prompt)
    if player == 'quit':
        break
    elif player in banned_users:
        print(player + " is banned!")
        continue
    else:
        players.append(player)

print("\nYour team:")
for player in players:
    print(player)
```

## Avoiding infinite loops

Every while loop needs a way to stop running so it won't continue to run forever. If there's no way for the condition to become False, the loop will never stop running.

### An infinite loop

```
while True:
    name = input("\nWho are you? ")
    print("Nice to meet you, " + name + "!")
```

## Removing all instances of a value from a list

The `remove()` method removes a specific value from a list, but it only removes the first instance of the value you provide. You can use a while loop to remove all instances of a particular value.

### Removing all cats from a list of pets

```
pets = ['dog', 'cat', 'dog', 'fish', 'cat',
        'rabbit', 'cat']

print(pets)

while 'cat' in pets:
    pets.remove('cat')

print(pets)
```

More cheat sheets available at  
[ehmatthes.github.io/pcc/](https://ehmatthes.github.io/pcc/)

# Beginner's Python Cheat Sheet — Functions

## What are functions?

Functions are named blocks of code designed to do one specific job. Functions allow you to write code once that can then be run whenever you need to accomplish the same task. Functions can take in the information they need, and return the information they generate. Using functions effectively makes your programs easier to write, read, test, and fix.

## Defining a function

The first line of a function is its definition, marked by the keyword `def`. The name of the function is followed by a set of parentheses and a colon. A docstring, in triple quotes, describes what the function does. The body of a function is indented one level.

To call a function, give the name of the function followed by a set of parentheses.

## Making a function

```
def greet_user():
    """Display a simple greeting."""
    print("Hello!")

greet_user()
```

## Passing information to a function

Information that's passed to a function is called an argument; information that's received by a function is called a parameter. Arguments are included in parentheses after the function's name, and parameters are listed in parentheses in the function's definition.

## Passing a single argument

```
def greet_user(username):
    """Display a simple greeting."""
    print("Hello, " + username + "!")

greet_user('jesse')
greet_user('diana')
greet_user('brandon')
```

## Positional and keyword arguments

The two main kinds of arguments are positional and keyword arguments. When you use positional arguments Python matches the first argument in the function call with the first parameter in the function definition, and so forth.

With keyword arguments, you specify which parameter each argument should be assigned to in the function call. When you use keyword arguments, the order of the arguments doesn't matter.

## Using positional arguments

```
def describe_pet(animal, name):
    """Display information about a pet."""
    print("\nI have a " + animal + ".")
    print("Its name is " + name + ".")
```

```
describe_pet('hamster', 'harry')
describe_pet('dog', 'willie')
```

## Using keyword arguments

```
def describe_pet(animal, name):
    """Display information about a pet."""
    print("\nI have a " + animal + ".")
    print("Its name is " + name + ".")
```

```
describe_pet(animal='hamster', name='harry')
describe_pet(name='willie', animal='dog')
```

## Default values

You can provide a default value for a parameter. When function calls omit this argument the default value will be used. Parameters with default values must be listed after parameters without default values in the function's definition so positional arguments can still work correctly.

## Using a default value

```
def describe_pet(name, animal='dog'):
    """Display information about a pet."""
    print("\nI have a " + animal + ".")
    print("Its name is " + name + ".")
```

```
describe_pet('harry', 'hamster')
describe_pet('willie')
```

## Using None to make an argument optional

```
def describe_pet(animal, name=None):
    """Display information about a pet."""
    print("\nI have a " + animal + ".")
    if name:
        print("Its name is " + name + ".")
```

```
describe_pet('hamster', 'harry')
describe_pet('snake')
```

## Return values

A function can return a value or a set of values. When a function returns a value, the calling line must provide a variable in which to store the return value. A function stops running when it reaches a `return` statement.

## Returning a single value

```
def get_full_name(first, last):
    """Return a neatly formatted full name."""
    full_name = first + ' ' + last
    return full_name.title()
```

```
musician = get_full_name('jimi', 'hendrix')
print(musician)
```

## Returning a dictionary

```
def build_person(first, last):
    """Return a dictionary of information about a person."""
    person = {'first': first, 'last': last}
    return person
```

```
musician = build_person('jimi', 'hendrix')
print(musician)
```

## Returning a dictionary with optional values

```
def build_person(first, last, age=None):
    """Return a dictionary of information about a person."""
    person = {'first': first, 'last': last}
    if age:
        person['age'] = age
    return person
```

```
musician = build_person('jimi', 'hendrix', 27)
print(musician)
```

```
musician = build_person('janis', 'joplin')
print(musician)
```

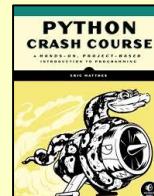
## Visualizing functions

Try running some of these examples on [pythontutor.com](http://pythontutor.com).

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## Passing a list to a function

You can pass a list as an argument to a function, and the function can work with the values in the list. Any changes the function makes to the list will affect the original list. You can prevent a function from modifying a list by passing a copy of the list as an argument.

### Passing a list as an argument

```
def greet_users(names):
    """Print a simple greeting to everyone."""
    for name in names:
        msg = "Hello, " + name + "!"
        print(msg)

usernames = ['hannah', 'ty', 'margot']
greet_users(usernames)
```

### Allowing a function to modify a list

The following example sends a list of models to a function for printing. The original list is emptied, and the second list is filled.

```
def print_models(unprinted, printed):
    """3d print a set of models."""
    while unprinted:
        current_model = unprinted.pop()
        print("Printing " + current_model)
        printed.append(current_model)

# Store some unprinted designs,
# and print each of them.
unprinted = ['phone case', 'pendant', 'ring']
printed = []
print_models(unprinted, printed)

print("\nUnprinted:", unprinted)
print("Printed:", printed)
```

### Preventing a function from modifying a list

The following example is the same as the previous one, except the original list is unchanged after calling `print_models()`.

```
def print_models(unprinted, printed):
    """3d print a set of models."""
    while unprinted:
        current_model = unprinted.pop()
        print("Printing " + current_model)
        printed.append(current_model)

# Store some unprinted designs,
# and print each of them.
original = ['phone case', 'pendant', 'ring']
printed = []

print_models(original[:], printed)
print("\nOriginal:", original)
print("Printed:", printed)
```

## Passing an arbitrary number of arguments

Sometimes you won't know how many arguments a function will need to accept. Python allows you to collect an arbitrary number of arguments into one parameter using the `*` operator. A parameter that accepts an arbitrary number of arguments must come last in the function definition.

The `**` operator allows a parameter to collect an arbitrary number of keyword arguments.

### Collecting an arbitrary number of arguments

```
def make_pizza(size, *toppings):
    """Make a pizza."""
    print("\nMaking a " + size + " pizza.")
    print("Toppings:")
    for topping in toppings:
        print("- " + topping)

# Make three pizzas with different toppings.
make_pizza('small', 'pepperoni')
make_pizza('large', 'bacon bits', 'pineapple')
make_pizza('medium', 'mushrooms', 'peppers',
           'onions', 'extra cheese')
```

### Collecting an arbitrary number of keyword arguments

```
def build_profile(first, last, **user_info):
    """Build a user's profile dictionary."""
    # Build a dict with the required keys.
    profile = {'first': first, 'last': last}

    # Add any other keys and values.
    for key, value in user_info.items():
        profile[key] = value

    return profile

# Create two users with different kinds
# of information.
user_0 = build_profile('albert', 'einstein',
                       location='princeton')
user_1 = build_profile('marie', 'curie',
                       location='paris', field='chemistry')

print(user_0)
print(user_1)
```

## What's the best way to structure a function?

As you can see there are many ways to write and call a function. When you're starting out, aim for something that simply works. As you gain experience you'll develop an understanding of the more subtle advantages of different structures such as positional and keyword arguments, and the various approaches to importing functions. For now if your functions do what you need them to, you're doing well.

## Modules

You can store your functions in a separate file called a module, and then import the functions you need into the file containing your main program. This allows for cleaner program files. (Make sure your module is stored in the same directory as your main program.)

### Storing a function in a module

File: `pizza.py`

```
def make_pizza(size, *toppings):
    """Make a pizza."""
    print("\nMaking a " + size + " pizza.")
    print("Toppings:")
    for topping in toppings:
        print("- " + topping)
```

### Importing an entire module

File: `making_pizzas.py`

Every function in the module is available in the program file.

```
import pizza
```

```
pizza.make_pizza('medium', 'pepperoni')
pizza.make_pizza('small', 'bacon', 'pineapple')
```

### Importing a specific function

Only the imported functions are available in the program file.

```
from pizza import make_pizza
```

```
make_pizza('medium', 'pepperoni')
make_pizza('small', 'bacon', 'pineapple')
```

### Giving a module an alias

```
import pizza as p
```

```
p.make_pizza('medium', 'pepperoni')
p.make_pizza('small', 'bacon', 'pineapple')
```

### Giving a function an alias

```
from pizza import make_pizza as mp
```

```
mp('medium', 'pepperoni')
mp('small', 'bacon', 'pineapple')
```

### Importing all functions from a module

Don't do this, but recognize it when you see it in others' code. It can result in naming conflicts, which can cause errors.

```
from pizza import *
```

```
make_pizza('medium', 'pepperoni')
make_pizza('small', 'bacon', 'pineapple')
```

More cheat sheets available at  
[ehmatthes.github.io/pcc/](http://ehmatthes.github.io/pcc/)

# Beginner's Python Cheat Sheet - Classes

## What are classes?

Classes are the foundation of object-oriented programming. Classes represent real-world things you want to model in your programs: for example dogs, cars, and robots. You use a class to make objects, which are specific instances of dogs, cars, and robots. A class defines the general behavior that a whole category of objects can have, and the information that can be associated with those objects.

Classes can inherit from each other – you can write a class that extends the functionality of an existing class. This allows you to code efficiently for a wide variety of situations.

## Creating and using a class

Consider how we might model a car. What information would we associate with a car, and what behavior would it have? The information is stored in variables called attributes, and the behavior is represented by functions. Functions that are part of a class are called methods.

### The Car class

```
class Car():
    """A simple attempt to model a car."""

    def __init__(self, make, model, year):
        """Initialize car attributes."""
        self.make = make
        self.model = model
        self.year = year

        # Fuel capacity and level in gallons.
        self.fuel_capacity = 15
        self.fuel_level = 0

    def fill_tank(self):
        """Fill gas tank to capacity."""
        self.fuel_level = self.fuel_capacity
        print("Fuel tank is full.")

    def drive(self):
        """Simulate driving."""
        print("The car is moving.")
```

## Creating and using a class (cont.)

### Creating an object from a class

```
my_car = Car('audi', 'a4', 2016)
```

### Accessing attribute values

```
print(my_car.make)
print(my_car.model)
print(my_car.year)
```

### Calling methods

```
my_car.fill_tank()
my_car.drive()
```

### Creating multiple objects

```
my_car = Car('audi', 'a4', 2016)
my_old_car = Car('subaru', 'outback', 2013)
my_truck = Car('toyota', 'tacoma', 2010)
```

## Modifying attributes

You can modify an attribute's value directly, or you can write methods that manage updating values more carefully.

### Modifying an attribute directly

```
my_new_car = Car('audi', 'a4', 2016)
my_new_car.fuel_level = 5
```

### Writing a method to update an attribute's value

```
def update_fuel_level(self, new_level):
    """Update the fuel level."""
    if new_level <= self.fuel_capacity:
        self.fuel_level = new_level
    else:
        print("The tank can't hold that much!")
```

### Writing a method to increment an attribute's value

```
def add_fuel(self, amount):
    """Add fuel to the tank."""
    if (self.fuel_level + amount
        <= self.fuel_capacity):
        self.fuel_level += amount
        print("Added fuel.")
    else:
        print("The tank won't hold that much.")
```

## Naming conventions

In Python class names are written in CamelCase and object names are written in lowercase with underscores. Modules that contain classes should still be named in lowercase with underscores.

## Class inheritance

If the class you're writing is a specialized version of another class, you can use inheritance. When one class inherits from another, it automatically takes on all the attributes and methods of the parent class. The child class is free to introduce new attributes and methods, and override attributes and methods of the parent class.

To inherit from another class include the name of the parent class in parentheses when defining the new class.

### The `__init__()` method for a child class

```
class ElectricCar(Car):
    """A simple model of an electric car."""

    def __init__(self, make, model, year):
        """Initialize an electric car."""
        super().__init__(make, model, year)

        # Attributes specific to electric cars.
        # Battery capacity in kWh.
        self.battery_size = 70
        # Charge level in %.
        self.charge_level = 0
```

### Adding new methods to the child class

```
class ElectricCar(Car):
    --snip--
    def charge(self):
        """Fully charge the vehicle."""
        self.charge_level = 100
        print("The vehicle is fully charged.")
```

### Using child methods and parent methods

```
my_ecar = ElectricCar('tesla', 'model s', 2016)

my_ecar.charge()
my_ecar.drive()
```

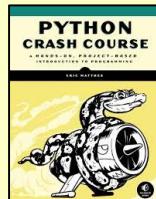
## Finding your workflow

There are many ways to model real world objects and situations in code, and sometimes that variety can feel overwhelming. Pick an approach and try it – if your first attempt doesn't work, try a different approach.

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## Class inheritance (cont.)

### Overriding parent methods

```
class ElectricCar(Car):
    --snip--
    def fill_tank(self):
        """Display an error message."""
        print("This car has no fuel tank!")
```

### Instances as attributes

A class can have objects as attributes. This allows classes to work together to model complex situations.

### A Battery class

```
class Battery():
    """A battery for an electric car."""

    def __init__(self, size=70):
        """Initialize battery attributes."""
        # Capacity in kWh, charge level in %.
        self.size = size
        self.charge_level = 0

    def get_range(self):
        """Return the battery's range."""
        if self.size == 70:
            return 240
        elif self.size == 85:
            return 270
```

### Using an instance as an attribute

```
class ElectricCar(Car):
    --snip--

    def __init__(self, make, model, year):
        """Initialize an electric car."""
        super().__init__(make, model, year)

        # Attribute specific to electric cars.
        self.battery = Battery()

    def charge(self):
        """Fully charge the vehicle."""
        self.battery.charge_level = 100
        print("The vehicle is fully charged.")
```

### Using the instance

```
my_ecar = ElectricCar('tesla', 'model x', 2016)

my_ecar.charge()
print(my_ecar.battery.get_range())
my_ecar.drive()
```

## Importing classes

Class files can get long as you add detailed information and functionality. To help keep your program files uncluttered, you can store your classes in modules and import the classes you need into your main program.

### Storing classes in a file

*car.py*

"""Represent gas and electric cars."""

```
class Car():
    """A simple attempt to model a car."""
    --snip--
```

```
class Battery():
    """A battery for an electric car."""
    --snip--
```

```
class ElectricCar(Car):
    """A simple model of an electric car."""
    --snip--
```

### Importing individual classes from a module

```
from car import Car, ElectricCar

my_beetle = Car('volkswagen', 'beetle', 2016)
my_beetle.fill_tank()
my_beetle.drive()

my_tesla = ElectricCar('tesla', 'model s', 2016)
my_tesla.charge()
my_tesla.drive()
```

### Importing an entire module

```
import car

my_beetle = car.Car(
    'volkswagen', 'beetle', 2016)
my_beetle.fill_tank()
my_beetle.drive()

my_tesla = car.ElectricCar(
    'tesla', 'model s', 2016)
my_tesla.charge()
my_tesla.drive()
```

### Importing all classes from a module

(Don't do this, but recognize it when you see it.)

```
from car import *

my_beetle = Car('volkswagen', 'beetle', 2016)
```

## Classes in Python 2.7

Classes should inherit from object

```
class ClassName(object):
```

### The Car class in Python 2.7

```
class Car(object):
```

Child class `__init__()` method is different

```
class ChildClassName(ParentClass):
    def __init__(self):
        super(ClassName, self).__init__()
```

### The ElectricCar class in Python 2.7

```
class ElectricCar(Car):
    def __init__(self, make, model, year):
        super(ElectricCar, self).__init__(
            make, model, year)
```

### Storing objects in a list

A list can hold as many items as you want, so you can make a large number of objects from a class and store them in a list.

Here's an example showing how to make a fleet of rental cars, and make sure all the cars are ready to drive.

### A fleet of rental cars

```
from car import Car, ElectricCar
```

```
# Make lists to hold a fleet of cars.
gas_fleet = []
electric_fleet = []
```

```
# Make 500 gas cars and 250 electric cars.
for _ in range(500):
    car = Car('ford', 'focus', 2016)
    gas_fleet.append(car)
for _ in range(250):
    ecar = ElectricCar('nissan', 'leaf', 2016)
    electric_fleet.append(ecar)
```

```
# Fill the gas cars, and charge electric cars.
for car in gas_fleet:
    car.fill_tank()
for ecar in electric_fleet:
    ecar.charge()
```

```
print("Gas cars:", len(gas_fleet))
print("Electric cars:", len(electric_fleet))
```

More cheat sheets available at  
[ehmatthes.github.io/pcc/](http://ehmatthes.github.io/pcc/)

# Beginner's Python Cheat Sheet — Files and Exceptions

## What are files? What are exceptions?

Your programs can read information in from files, and they can write data to files. Reading from files allows you to work with a wide variety of information; writing to files allows users to pick up where they left off the next time they run your program. You can write text to files, and you can store Python structures such as lists in data files.

Exceptions are special objects that help your programs respond to errors in appropriate ways. For example if your program tries to open a file that doesn't exist, you can use exceptions to display an informative error message instead of having the program crash.

## Reading from a file

To read from a file your program needs to open the file and then read the contents of the file. You can read the entire contents of the file at once, or read the file line by line. The `with` statement makes sure the file is closed properly when the program has finished accessing the file.

### Reading an entire file at once

```
filename = 'siddhartha.txt'

with open(filename) as f_obj:
    contents = f_obj.read()

print(contents)
```

### Reading line by line

Each line that's read from the file has a newline character at the end of the line, and the `print` function adds its own newline character. The `rstrip()` method gets rid of the extra blank lines this would result in when printing to the terminal.

```
filename = 'siddhartha.txt'

with open(filename) as f_obj:
    for line in f_obj:
        print(line.rstrip())
```

## Reading from a file (cont.)

### Storing the lines in a list

```
filename = 'siddhartha.txt'

with open(filename) as f_obj:
    lines = f_obj.readlines()

for line in lines:
    print(line.rstrip())
```

## Writing to a file

*Passing the 'w' argument to `open()` tells Python you want to write to the file. Be careful; this will erase the contents of the file if it already exists. Passing the 'a' argument tells Python you want to append to the end of an existing file.*

### Writing to an empty file

```
filename = 'programming.txt'

with open(filename, 'w') as f:
    f.write("I love programming!")
```

### Writing multiple lines to an empty file

```
filename = 'programming.txt'

with open(filename, 'w') as f:
    f.write("I love programming!\n")
    f.write("I love creating new games.\n")
```

### Appending to a file

```
filename = 'programming.txt'

with open(filename, 'a') as f:
    f.write("I also love working with data.\n")
    f.write("I love making apps as well.\n")
```

## File paths

*When Python runs the `open()` function, it looks for the file in the same directory where the program that's being executed is stored. You can open a file from a subfolder using a relative path. You can also use an absolute path to open any file on your system.*

### Opening a file from a subfolder

```
f_path = "text_files/alice.txt"

with open(f_path) as f_obj:
    lines = f_obj.readlines()

for line in lines:
    print(line.rstrip())
```

## File paths (cont.)

### Opening a file using an absolute path

```
f_path = "/home/ehmatthes/books/alice.txt"

with open(f_path) as f_obj:
    lines = f_obj.readlines()
```

### Opening a file on Windows

*Windows will sometimes interpret forward slashes incorrectly. If you run into this, use backslashes in your file paths.*

```
f_path = "C:\Users\ehmatthes\books\alice.txt"

with open(f_path) as f_obj:
    lines = f_obj.readlines()
```

## The try-except block

*When you think an error may occur, you can write a `try-except` block to handle the exception that might be raised. The `try` block tells Python to try running some code, and the `except` block tells Python what to do if the code results in a particular kind of error.*

### Handling the ZeroDivisionError exception

```
try:
    print(5/0)
except ZeroDivisionError:
    print("You can't divide by zero!")
```

### Handling the FileNotFoundError exception

```
f_name = 'siddhartha.txt'

try:
    with open(f_name) as f_obj:
        lines = f_obj.readlines()
except FileNotFoundError:
    msg = "Can't find file {}".format(f_name)
    print(msg)
```

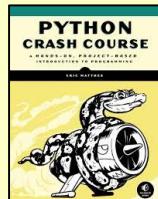
## Knowing which exception to handle

*It can be hard to know what kind of exception to handle when writing code. Try writing your code without a `try` block, and make it generate an error. The traceback will tell you what kind of exception your program needs to handle.*

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## The else block

The `try` block should only contain code that may cause an error. Any code that depends on the `try` block running successfully should be placed in the `else` block.

### Using an else block

```
print("Enter two numbers. I'll divide them.")

x = input("First number: ")
y = input("Second number: ")

try:
    result = int(x) / int(y)
except ZeroDivisionError:
    print("You can't divide by zero!")
else:
    print(result)
```

### Preventing crashes from user input

Without the `except` block in the following example, the program would crash if the user tries to divide by zero. As written, it will handle the error gracefully and keep running.

```
"""A simple calculator for division only."""

print("Enter two numbers. I'll divide them.")
print("Enter 'q' to quit.")

while True:
    x = input("\nFirst number: ")
    if x == 'q':
        break
    y = input("Second number: ")
    if y == 'q':
        break

    try:
        result = int(x) / int(y)
    except ZeroDivisionError:
        print("You can't divide by zero!")
    else:
        print(result)
```

## Deciding which errors to report

Well-written, properly tested code is not very prone to internal errors such as syntax or logical errors. But every time your program depends on something external such as user input or the existence of a file, there's a possibility of an exception being raised.

It's up to you how to communicate errors to your users. Sometimes users need to know if a file is missing; sometimes it's better to handle the error silently. A little experience will help you know how much to report.

## Failing silently

Sometimes you want your program to just continue running when it encounters an error, without reporting the error to the user. Using the `pass` statement in an `else` block allows you to do this.

### Using the pass statement in an else block

```
f_names = ['alice.txt', 'siddhartha.txt',
           'moby_dick.txt', 'little_women.txt']

for f_name in f_names:
    # Report the length of each file found.
    try:
        with open(f_name) as f_obj:
            lines = f_obj.readlines()
    except FileNotFoundError:
        # Just move on to the next file.
        pass
    else:
        num_lines = len(lines)
        msg = "{0} has {1} lines.".format(
            f_name, num_lines)
        print(msg)
```

## Avoid bare except blocks

Exception-handling code should catch specific exceptions that you expect to happen during your program's execution. A bare `except` block will catch all exceptions, including keyboard interrupts and system exits you might need when forcing a program to close.

If you want to use a `try` block and you're not sure which exception to catch, use `Exception`. It will catch most exceptions, but still allow you to interrupt programs intentionally.

### Don't use bare except blocks

```
try:
    # Do something
except:
    pass
```

### Use Exception instead

```
try:
    # Do something
except Exception:
    pass
```

### Printing the exception

```
try:
    # Do something
except Exception as e:
    print(e, type(e))
```

## Storing data with json

The `json` module allows you to dump simple Python data structures into a file, and load the data from that file the next time the program runs. The JSON data format is not specific to Python, so you can share this kind of data with people who work in other languages as well.

Knowing how to manage exceptions is important when working with stored data. You'll usually want to make sure the data you're trying to load exists before working with it.

### Using `json.dump()` to store data

```
"""Store some numbers."""

import json

numbers = [2, 3, 5, 7, 11, 13]

filename = 'numbers.json'
with open(filename, 'w') as f_obj:
    json.dump(numbers, f_obj)
```

### Using `json.load()` to read data

```
"""Load some previously stored numbers."""

import json

filename = 'numbers.json'
with open(filename) as f_obj:
    numbers = json.load(f_obj)

print(numbers)
```

### Making sure the stored data exists

```
import json

f_name = 'numbers.json'

try:
    with open(f_name) as f_obj:
        numbers = json.load(f_obj)
except FileNotFoundError:
    msg = "Can't find {0}.".format(f_name)
    print(msg)
else:
    print(numbers)
```

### Practice with exceptions

Take a program you've already written that prompts for user input, and add some error-handling code to the program.

More cheat sheets available at  
[ehmatthes.github.io/pcc/](https://ehmatthes.github.io/pcc/)

# Beginner's Python Cheat Sheet — Testing Your Code

## Why test your code?

When you write a function or a class, you can also write tests for that code. Testing proves that your code works as it's supposed to in the situations it's designed to handle, and also when people use your programs in unexpected ways. Writing tests gives you confidence that your code will work correctly as more people begin to use your programs. You can also add new features to your programs and know that you haven't broken existing behavior.

A unit test verifies that one specific aspect of your code works as it's supposed to. A test case is a collection of unit tests which verify your code's behavior in a wide variety of situations.

## Testing a function: A passing test

Python's `unittest` module provides tools for testing your code. To try it out, we'll create a function that returns a full name. We'll use the function in a regular program, and then build a test case for the function.

### A function to test

Save this as `full_names.py`

```
def get_full_name(first, last):
    """Return a full name."""
    full_name = "{0} {1}".format(first, last)
    return full_name.title()
```

### Using the function

Save this as `names.py`

```
from full_names import get_full_name

janis = get_full_name('janis', 'joplin')
print(janis)

bob = get_full_name('bob', 'dylan')
print(bob)
```

## Testing a function (cont.)

### Building a testcase with one unit test

To build a test case, make a class that inherits from `unittest.TestCase` and write methods that begin with `test_`. Save this as `test_full_names.py`.

```
import unittest
from full_names import get_full_name

class NamesTestCase(unittest.TestCase):
    """Tests for names.py."""

    def test_first_last(self):
        """Test names like Janis Joplin."""
        full_name = get_full_name('janis',
                                 'joplin')
        self.assertEqual(full_name,
                        'Janis Joplin')

unittest.main()
```

### Running the test

Python reports on each unit test in the test case. The dot reports a single passing test. Python informs us that it ran 1 test in less than 0.001 seconds, and the OK lets us know that all unit tests in the test case passed.

.

Ran 1 test in 0.000s

OK

## Testing a function: A failing test

Failing tests are important; they tell you that a change in the code has affected existing behavior. When a test fails, you need to modify the code so the existing behavior still works.

### Modifying the function

We'll modify `get_full_name()` so it handles middle names, but we'll do it in a way that breaks existing behavior.

```
def get_full_name(first, middle, last):
    """Return a full name."""
    full_name = "{0} {1} {2}".format(first,
                                    middle,
                                    last)
    return full_name.title()
```

### Using the function

```
from full_names import get_full_name

john = get_full_name('john', 'lee', 'hooker')
print(john)

david = get_full_name('david', 'lee', 'roth')
print(david)
```

## A failing test (cont.)

### Running the test

When you change your code, it's important to run your existing tests. This will tell you whether the changes you made affected existing behavior.

E

=====

ERROR: test\_first\_last (`__main__.NamesTestCase`)  
Test names like Janis Joplin.

-----

Traceback (most recent call last):

```
  File "test_full_names.py", line 10,
    in test_first_last
      'joplin')
TypeError: get_full_name() missing 1 required
          positional argument: 'last'
```

-----

Ran 1 test in 0.001s

FAILED (errors=1)

### Fixing the code

When a test fails, the code needs to be modified until the test passes again. (Don't make the mistake of rewriting your tests to fit your new code.) Here we can make the middle name optional.

```
def get_full_name(first, last, middle=''):
    """Return a full name."""
    if middle:
        full_name = "{0} {1} {2}".format(first,
                                        middle,
                                        last)
    else:
        full_name = "{0} {1}".format(first,
                                    last)
    return full_name.title()
```

### Running the test

Now the test should pass again, which means our original functionality is still intact.

.

-----

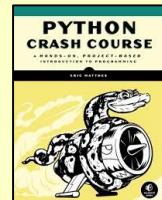
Ran 1 test in 0.000s

OK

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## Adding new tests

You can add as many unit tests to a test case as you need. To write a new test, add a new method to your test case class.

### Testing middle names

We've shown that `get_full_name()` works for first and last names. Let's test that it works for middle names as well.

```
import unittest
from full_names import get_full_name

class NamesTestCase(unittest.TestCase):
    """Tests for names.py."""

    def test_first_last(self):
        """Test names like Janis Joplin."""
        full_name = get_full_name('janis',
                                  'joplin')
        self.assertEqual(full_name,
                        'Janis Joplin')

    def test_middle(self):
        """Test names like David Lee Roth."""
        full_name = get_full_name('david',
                                  'roth', 'lee')
        self.assertEqual(full_name,
                        'David Lee Roth')

unittest.main()
```

### Running the tests

The two dots represent two passing tests.

```
..
-----
Ran 2 tests in 0.000s
OK
```

## A variety of assert methods

Python provides a number of assert methods you can use to test your code.

### Verify that `a==b`, or `a != b`

```
assertEqual(a, b)
assertNotEqual(a, b)
```

### Verify that `x` is True, or `x` is False

```
assertTrue(x)
assertFalse(x)
```

### Verify an item is in a list, or not in a list

```
assertIn(item, list)
assertNotIn(item, list)
```

## Testing a class

Testing a class is similar to testing a function, since you'll mostly be testing your methods.

### A class to test

Save as `accountant.py`

```
class Accountant():
    """Manage a bank account."""

    def __init__(self, balance=0):
        self.balance = balance

    def deposit(self, amount):
        self.balance += amount

    def withdraw(self, amount):
        self.balance -= amount
```

### Building a testcase

For the first test, we'll make sure we can start out with different initial balances. Save this as `test_accountant.py`.

```
import unittest
from accountant import Accountant

class TestAccountant(unittest.TestCase):
    """Tests for the class Accountant."""

    def test_initial_balance(self):
        # Default balance should be 0.
        acc = Accountant()
        self.assertEqual(acc.balance, 0)

        # Test non-default balance.
        acc = Accountant(100)
        self.assertEqual(acc.balance, 100)

unittest.main()
```

### Running the test

```
..
-----
Ran 1 test in 0.000s
OK
```

## When is it okay to modify tests?

In general you shouldn't modify a test once it's written. When a test fails it usually means new code you've written has broken existing functionality, and you need to modify the new code until all existing tests pass.

If your original requirements have changed, it may be appropriate to modify some tests. This usually happens in the early stages of a project when desired behavior is still being sorted out.

## The `setUp()` method

When testing a class, you usually have to make an instance of the class. The `setUp()` method is run before every test. Any instances you make in `setUp()` are available in every test you write.

### Using `setUp()` to support multiple tests

The instance `self.acc` can be used in each new test.

```
import unittest
from accountant import Accountant

class TestAccountant(unittest.TestCase):
    """Tests for the class Accountant."""

    def setUp(self):
        self.acc = Accountant()

    def test_initial_balance(self):
        # Default balance should be 0.
        self.assertEqual(self.acc.balance, 0)

        # Test non-default balance.
        acc = Accountant(100)
        self.assertEqual(acc.balance, 100)

    def test_deposit(self):
        # Test single deposit.
        self.acc.deposit(100)
        self.assertEqual(self.acc.balance, 100)

        # Test multiple deposits.
        self.acc.deposit(100)
        self.acc.deposit(100)
        self.assertEqual(self.acc.balance, 300)

    def test_withdrawal(self):
        # Test single withdrawal.
        self.acc.deposit(1000)
        self.acc.withdraw(100)
        self.assertEqual(self.acc.balance, 900)

unittest.main()
```

### Running the tests

```
...
-----
Ran 3 tests in 0.001s
OK
```

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# Beginner's Python Cheat Sheet - Pygame

## What is Pygame?

Pygame is a framework for making games using Python. Making games is fun, and it's a great way to expand your programming skills and knowledge. Pygame takes care of many of the lower-level tasks in building games, which lets you focus on the aspects of your game that make it interesting.

## Installing Pygame

Pygame runs on all systems, but setup is slightly different on each OS. The instructions here assume you're using Python 3, and provide a minimal installation of Pygame. If these instructions don't work for your system, see the more detailed notes at <http://ehmatthes.github.io/pcc/>.

### Pygame on Linux

```
$ sudo apt-get install python3-dev mercurial  
    libsdl-image1.2-dev libsdl2-dev  
    libsdl-ttf2.0-dev  
$ pip install --user  
    hg+http://bitbucket.org/pygame/pygame
```

### Pygame on OS X

This assumes you've used Homebrew to install Python 3.

```
$ brew install hg sdl sdl_image sdl_ttf  
$ pip install --user  
    hg+http://bitbucket.org/pygame/pygame
```

### Pygame on Windows

Find an installer at <https://bitbucket.org/pygame/pygame/downloads/> or <http://www.lfd.uci.edu/~gohlke/pythonlibs/#pygame> that matches your version of Python. Run the installer file if it's a .exe or .msi file. If it's a .whl file, use pip to install Pygame:

```
> python -m pip install --user  
    pygame-1.9.2a0-cp35-none-win32.whl
```

## Testing your installation

To test your installation, open a terminal session and try to import Pygame. If you don't get any error messages, your installation was successful.

```
$ python  
->>> import pygame  
->>>
```

## Starting a game

The following code sets up an empty game window, and starts an event loop and a loop that continually refreshes the screen.

### An empty game window

```
import sys  
import pygame as pg  
  
def run_game():  
    # Initialize and set up screen.  
    pg.init()  
    screen = pg.display.set_mode((1200, 800))  
    pg.display.set_caption("Alien Invasion")  
  
    # Start main loop.  
    while True:  
        # Start event loop.  
        for event in pg.event.get():  
            if event.type == pg.QUIT:  
                sys.exit()  
  
        # Refresh screen.  
        pg.display.flip()  
  
run_game()
```

### Setting a custom window size

The `display.set_mode()` function accepts a tuple that defines the screen size.

```
screen_dim = (1200, 800)  
screen = pg.display.set_mode(screen_dim)
```

### Setting a custom background color

Colors are defined as a tuple of red, green, and blue values. Each value ranges from 0-255.

```
bg_color = (230, 230, 230)  
screen.fill(bg_color)
```

## Pygame rect objects

Many objects in a game can be treated as simple rectangles, rather than their actual shape. This simplifies code without noticeably affecting game play. Pygame has a `rect` object that makes it easy to work with game objects.

### Getting the screen rect object

We already have a `screen` object; we can easily access the `rect` object associated with the screen.

```
screen_rect = screen.get_rect()
```

### Finding the center of the screen

`Rect` objects have a `center` attribute which stores the center point.

```
screen_center = screen_rect.center
```

## Pygame rect objects (cont.)

### Useful rect attributes

Once you have a `rect` object, there are a number of attributes that are useful when positioning objects and detecting relative positions of objects. (You can find more attributes in the Pygame documentation.)

```
# Individual x and y values:  
screen_rect.left, screen_rect.right  
screen_rect.top, screen_rect.bottom  
screen_rect.centerx, screen_rect.centery  
screen_rect.width, screen_rect.height
```

```
# Tuples  
screen_rect.center  
screen_rect.size
```

### Creating a rect object

You can create a `rect` object from scratch. For example a small `rect` object that's filled in can represent a bullet in a game. The `Rect()` class takes the coordinates of the upper left corner, and the width and height of the rect. The `draw.rect()` function takes a screen object, a color, and a `rect`. This function fills the given `rect` with the given color.

```
bullet_rect = pg.Rect(100, 100, 3, 15)  
color = (100, 100, 100)  
pg.draw.rect(screen, color, bullet_rect)
```

## Working with images

Many objects in a game are images that are moved around the screen. It's easiest to use bitmap (.bmp) image files, but you can also configure your system to work with jpg, png, and gif files as well.

### Loading an image

```
ship = pg.image.load('images/ship.bmp')
```

### Getting the rect object from an image

```
ship_rect = ship.get_rect()
```

### Positioning an image

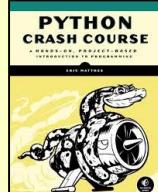
With `rects`, it's easy to position an image wherever you want on the screen, or in relation to another object. The following code positions a `ship` object at the bottom center of the screen.

```
ship_rect.midbottom = screen_rect.midbottom
```

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## Working with images (cont.)

### Drawing an image to the screen

Once an image is loaded and positioned, you can draw it to the screen with the `blit()` method. The `blit()` method acts on the screen object, and takes the image object and image rect as arguments.

```
# Draw ship to screen.  
screen.blit(ship, ship_rect)
```

### The blitme() method

Game objects such as ships are often written as classes. Then a `blitme()` method is usually defined, which draws the object to the screen.

```
def blitme(self):  
    """Draw ship at current location."""  
    self.screen.blit(self.image, self.rect)
```

## Responding to keyboard input

Pygame watches for events such as key presses and mouse actions. You can detect any event you care about in the event loop, and respond with any action that's appropriate for your game.

### Responding to key presses

Pygame's main event loop registers a `KEYDOWN` event any time a key is pressed. When this happens, you can check for specific keys.

```
for event in pg.event.get():  
    if event.type == pg.KEYDOWN:  
        if event.key == pg.K_RIGHT:  
            ship_rect.x += 1  
        elif event.key == pg.K_LEFT:  
            ship_rect.x -= 1  
        elif event.key == pg.K_SPACE:  
            ship.fire_bullet()  
        elif event.key == pg.K_q:  
            sys.exit()
```

### Responding to released keys

When the user releases a key, a `KEYUP` event is triggered.

```
if event.type == pg.KEYUP:  
    if event.key == pg.K_RIGHT:  
        ship.moving_right = False
```

## Pygame documentation

The Pygame documentation is really helpful when building your own games. The home page for the Pygame project is at <http://pygame.org/>, and the home page for the documentation is at <http://pygame.org/docs/>.

The most useful part of the documentation are the pages about specific parts of Pygame, such as the `Rect()` class and the `sprite` module. You can find a list of these elements at the top of the help pages.

## Responding to mouse events

Pygame's event loop registers an event any time the mouse moves, or a mouse button is pressed or released.

### Responding to the mouse button

```
for event in pg.event.get():  
    if event.type == pg.MOUSEBUTTONDOWN:  
        ship.fire_bullet()
```

### Finding the mouse position

The mouse position is returned as a tuple.

```
mouse_pos = pg.mouse.get_pos()
```

### Clicking a button

You might want to know if the cursor is over an object such as a button. The `rect.collidepoint()` method returns true when a point is inside a rect object.

```
if button_rect.collidepoint(mouse_pos):  
    start_game()
```

### Hiding the mouse

```
pg.mouse.set_visible(False)
```

## Pygame groups

Pygame has a `Group` class which makes working with a group of similar objects easier. A group is like a list, with some extra functionality that's helpful when building games.

### Making and filling a group

An object that will be placed in a group must inherit from `Sprite`.

```
from pygame.sprite import Sprite, Group
```

```
def Bullet(Sprite):
```

```
    ...  
    def draw_bullet(self):
```

```
        ...  
    def update(self):
```

```
        ...
```

```
bullets = Group()
```

```
new_bullet = Bullet()
```

```
bullets.add(new_bullet)
```

### Looping through the items in a group

The `sprites()` method returns all the members of a group.

```
for bullet in bullets.sprites():  
    bullet.draw_bullet()
```

### Calling update() on a group

Calling `update()` on a group automatically calls `update()` on each member of the group.

```
bullets.update()
```

## Pygame groups (cont.)

### Removing an item from a group

It's important to delete elements that will never appear again in the game, so you don't waste memory and resources.

```
bullets.remove(bullet)
```

## Detecting collisions

You can detect when a single object collides with any member of a group. You can also detect when any member of one group collides with a member of another group.

Collisions between a single object and a group

The `sprite.collideany()` function takes an object and a group, and returns True if the object overlaps with any member of the group.

```
if pg.sprite.spritecollideany(ship, aliens):  
    ships_left -= 1
```

### Collisions between two groups

The `sprite.groupcollide()` function takes two groups, and two booleans. The function returns a dictionary containing information about the members that have collided. The booleans tell Pygame whether to delete the members of either group that have collided.

```
collisions = pg.sprite.groupcollide(  
    bullets, aliens, True, True)
```

```
score += len(collisions) * alien_point_value
```

## Rendering text

You can use text for a variety of purposes in a game. For example you can share information with players, and you can display a score.

### Displaying a message

The following code defines a message, then a color for the text and the background color for the message. A font is defined using the default system font, with a font size of 48. The `font.render()` function is used to create an image of the message, and we get the rect object associated with the image. We then center the image on the screen and display it.

```
msg = "Play again?"  
msg_color = (100, 100, 100)  
bg_color = (230, 230, 230)
```

```
f = pg.font.SysFont(None, 48)  
msg_image = f.render(msg, True, msg_color,  
    bg_color)  
msg_image_rect = msg_image.get_rect()  
msg_image_rect.center = screen_rect.center  
screen.blit(msg_image, msg_image_rect)
```

More cheat sheets available at  
[ehmatthes.github.io/pcc/](https://ehmatthes.github.io/pcc/)

# Beginner's Python Cheat Sheet — matplotlib

## What is matplotlib?

Data visualization involves exploring data through visual representations. The matplotlib package helps you make visually appealing representations of the data you're working with. matplotlib is extremely flexible; these examples will help you get started with a few simple visualizations.

## Installing matplotlib

matplotlib runs on all systems, but setup is slightly different depending on your OS. If the minimal instructions here don't work for you, see the more detailed instructions at <http://ehmatthes.github.io/pcc/>. You should also consider installing the Anaconda distribution of Python from <https://continuum.io/downloads/>, which includes matplotlib.

### matplotlib on Linux

```
$ sudo apt-get install python3-matplotlib
```

### matplotlib on OS X

Start a terminal session and enter `import matplotlib` to see if it's already installed on your system. If not, try this command:

```
$ pip install --user matplotlib
```

### matplotlib on Windows

You first need to install Visual Studio, which you can do from <https://dev.windows.com/>. The Community edition is free. Then go to <https://pypi.python.org/pypi/matplotlib/> or <http://www.lfd.uci.edu/~gohlke/pythonlibs/#matplotlib> and download an appropriate installer file.

## Line graphs and scatter plots

### Making a line graph

```
import matplotlib.pyplot as plt

x_values = [0, 1, 2, 3, 4, 5]
squares = [0, 1, 4, 9, 16, 25]
plt.plot(x_values, squares)
plt.show()
```

## Line graphs and scatter plots (cont.)

### Making a scatter plot

The `scatter()` function takes a list of `x` values and a list of `y` values, and a variety of optional arguments. The `s=10` argument controls the size of each point.

```
import matplotlib.pyplot as plt

x_values = list(range(1000))
squares = [x**2 for x in x_values]

plt.scatter(x_values, squares, s=10)
plt.show()
```

## Customizing plots

Plots can be customized in a wide variety of ways. Just about any element of a plot can be customized.

### Adding titles and labels, and scaling axes

```
import matplotlib.pyplot as plt

x_values = list(range(1000))
squares = [x**2 for x in x_values]
plt.scatter(x_values, squares, s=10)

plt.title("Square Numbers", fontsize=24)
plt.xlabel("Value", fontsize=18)
plt.ylabel("Square of Value", fontsize=18)
plt.tick_params(axis='both', which='major',
                labelsize=14)
plt.axis([0, 1100, 0, 1100000])

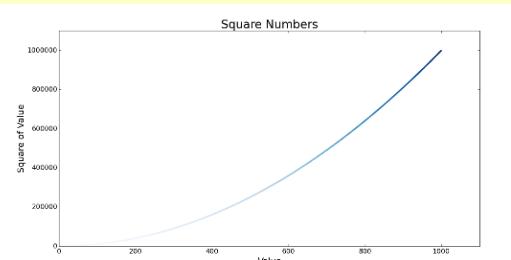
plt.show()
```

### Using a colormap

A colormap varies the point colors from one shade to another, based on a certain value for each point. The value used to determine the color of each point is passed to the `c` argument, and the `cmap` argument specifies which colormap to use.

The `edgecolor='none'` argument removes the black outline from each point.

```
plt.scatter(x_values, squares, c=squares,
            cmap=plt.cm.Blues, edgecolor='none',
            s=10)
```



## Customizing plots (cont.)

### Emphasizing points

You can plot as much data as you want on one plot. Here we re-plot the first and last points larger to emphasize them.

```
import matplotlib.pyplot as plt

x_values = list(range(1000))
squares = [x**2 for x in x_values]
plt.scatter(x_values, squares, c=squares,
            cmap=plt.cm.Blues, edgecolor='none',
            s=10)

plt.scatter(x_values[0], squares[0], c='green',
            edgecolor='none', s=100)
plt.scatter(x_values[-1], squares[-1], c='red',
            edgecolor='none', s=100)

plt.title("Square Numbers", fontsize=24)
--snip--
```

### Removing axes

You can customize or remove axes entirely. Here's how to access each axis, and hide it.

```
plt.axes().get_xaxis().set_visible(False)
plt.axes().get_yaxis().set_visible(False)
```

### Setting a custom figure size

You can make your plot as big or small as you want. Before plotting your data, add the following code. The `dpi` argument is optional; if you don't know your system's resolution you can omit the argument and adjust the `figsize` argument accordingly.

```
plt.figure(dpi=128, figsize=(10, 6))
```

### Saving a plot

The matplotlib viewer has an interactive save button, but you can also save your visualizations programmatically. To do so, replace `plt.show()` with `plt.savefig()`. The `bbox_inches='tight'` argument trims extra whitespace from the plot.

```
plt.savefig('squares.png', bbox_inches='tight')
```

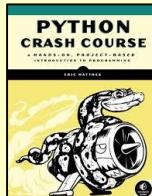
## Online resources

The matplotlib gallery and documentation are at <http://matplotlib.org/>. Be sure to visit the examples, gallery, and pyplot links.

## Python Crash Course

Covers Python 3 and Python 2

[nostarchpress.com/pythoncrashcourse](http://nostarchpress.com/pythoncrashcourse)



## Multiple plots

You can make as many plots as you want on one figure. When you make multiple plots, you can emphasize relationships in the data. For example you can fill the space between two sets of data.

### Plotting two sets of data

Here we use `plt.scatter()` twice to plot square numbers and cubes on the same figure.

```
import matplotlib.pyplot as plt

x_values = list(range(11))
squares = [x**2 for x in x_values]
cubes = [x**3 for x in x_values]

plt.scatter(x_values, squares, c='blue',
            edgecolor='none', s=20)
plt.scatter(x_values, cubes, c='red',
            edgecolor='none', s=20)

plt.axis([0, 11, 0, 1100])
plt.show()
```

### Filling the space between data sets

The `fill_between()` method fills the space between two data sets. It takes a series of x-values and two series of y-values. It also takes a facecolor to use for the fill, and an optional alpha argument that controls the color's transparency.

```
plt.fill_between(x_values, cubes, squares,
                 facecolor='blue', alpha=0.25)
```

## Working with dates and times

Many interesting data sets have a date or time as the x-value. Python's `datetime` module helps you work with this kind of data.

### Generating the current date

The `datetime.now()` function returns a `datetime` object representing the current date and time.

```
from datetime import datetime as dt

today = dt.now()
date_string = dt.strftime(today, '%m/%d/%Y')
print(date_string)
```

### Generating a specific date

You can also generate a `datetime` object for any date and time you want. The positional order of arguments is year, month, and day. The hour, minute, second, and microsecond arguments are optional.

```
from datetime import datetime as dt

new_years = dt(2017, 1, 1)
fall_equinox = dt(year=2016, month=9, day=22)
```

## Working with dates and times (cont.)

### Datetime formatting arguments

The `strftime()` function generates a formatted string from a `datetime` object, and the `strptime()` function generates a `datetime` object from a string. The following codes let you work with dates exactly as you need to.

%A	Weekday name, such as Monday
%B	Month name, such as January
%m	Month, as a number (01 to 12)
%d	Day of the month, as a number (01 to 31)
%Y	Four-digit year, such as 2016
%y	Two-digit year, such as 16
%H	Hour, in 24-hour format (00 to 23)
%I	Hour, in 12-hour format (01 to 12)
%p	AM or PM
%M	Minutes (00 to 59)
%S	Seconds (00 to 61)

### Converting a string to a datetime object

```
new_years = dt.strptime('1/1/2017', '%m/%d/%Y')
```

### Converting a datetime object to a string

```
ny_string = dt.strftime(new_years, '%B %d, %Y')
print(ny_string)
```

### Plotting high temperatures

The following code creates a list of dates and a corresponding list of high temperatures. It then plots the high temperatures, with the date labels displayed in a specific format.

```
from datetime import datetime as dt

import matplotlib.pyplot as plt
from matplotlib import dates as mdates

dates = [
    dt(2016, 6, 21), dt(2016, 6, 22),
    dt(2016, 6, 23), dt(2016, 6, 24),
]

highs = [57, 68, 64, 59]

fig = plt.figure(dpi=128, figsize=(10,6))
plt.plot(dates, highs, c='red')
plt.title("Daily High Temps", fontsize=24)
plt.ylabel("Temp (F)", fontsize=16)

x_axis = plt.axes().get_xaxis()
x_axis.set_major_formatter(
    mdates.DateFormatter('%B %d %Y')
)
fig.autofmt_xdate()

plt.show()
```

## Multiple plots in one figure

You can include as many individual graphs in one figure as you want. This is useful, for example, when comparing related datasets.

### Sharing an x-axis

The following code plots a set of squares and a set of cubes on two separate graphs that share a common x-axis.

The `plt.subplots()` function returns a figure object and a tuple of axes. Each set of axes corresponds to a separate plot in the figure. The first two arguments control the number of rows and columns generated in the figure.

```
import matplotlib.pyplot as plt

x_vals = list(range(11))
squares = [x**2 for x in x_vals]
cubes = [x**3 for x in x_vals]

fig, axarr = plt.subplots(2, 1, sharex=True)

axarr[0].scatter(x_vals, squares)
axarr[0].set_title('Squares')

axarr[1].scatter(x_vals, cubes, c='red')
axarr[1].set_title('Cubes')

plt.show()
```

### Sharing a y-axis

To share a y-axis, we use the `sharey=True` argument.

```
import matplotlib.pyplot as plt

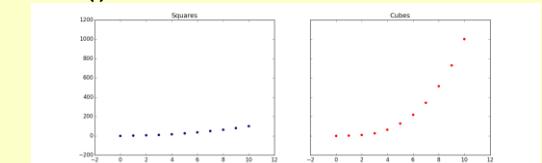
x_vals = list(range(11))
squares = [x**2 for x in x_vals]
cubes = [x**3 for x in x_vals]

fig, axarr = plt.subplots(1, 2, sharey=True)

axarr[0].scatter(x_vals, squares)
axarr[0].set_title('Squares')

axarr[1].scatter(x_vals, cubes, c='red')
axarr[1].set_title('Cubes')

plt.show()
```



More cheat sheets available at  
[ehmatthes.github.io/pcc/](https://ehmatthes.github.io/pcc/)

# Beginner's Python Cheat Sheet — Pygal

## What is Pygal?

Data visualization involves exploring data through visual representations. Pygal helps you make visually appealing representations of the data you're working with. Pygal is particularly well suited for visualizations that will be presented online, because it supports interactive elements.

## Installing Pygal

Pygal can be installed using pip.

### Pygal on Linux and OS X

```
$ pip install --user pygal
```

### Pygal on Windows

```
> python -m pip install --user pygal
```

## Line graphs, scatter plots, and bar graphs

To make a plot with Pygal, you specify the kind of plot and then add the data.

### Making a line graph

To view the output, open the file squares.svg in a browser.

```
import pygal

x_values = [0, 1, 2, 3, 4, 5]
squares = [0, 1, 4, 9, 16, 25]

chart = pygal.Line()
chart.force_uri_protocol = 'http'
chart.add('x^2', squares)
chart.render_to_file('squares.svg')
```

### Adding labels and a title

```
--snip--
chart = pygal.Line()
chart.force_uri_protocol = 'http'
chart.title = "Squares"
chart.x_labels = x_values
chart.x_title = "Value"
chart.y_title = "Square of Value"
chart.add('x^2', squares)
chart.render_to_file('squares.svg')
```

## Line graphs, scatter plots, and bar graphs (cont.)

### Making a scatter plot

The data for a scatter plot needs to be a list containing tuples of the form  $(x, y)$ . The `stroke=False` argument tells Pygal to make an XY chart with no line connecting the points.

```
import pygal

squares = [
    (0, 0), (1, 1), (2, 4), (3, 9),
    (4, 16), (5, 25),
]

chart = pygal.XY(stroke=False)
chart.force_uri_protocol = 'http'
chart.add('x^2', squares)
chart.render_to_file('squares.svg')
```

### Using a list comprehension for a scatter plot

A list comprehension can be used to efficiently make a dataset for a scatter plot.

```
squares = [(x, x**2) for x in range(1000)]
```

### Making a bar graph

A bar graph requires a list of values for the bar sizes. To label the bars, pass a list of the same length to `x_labels`.

```
import pygal

outcomes = [1, 2, 3, 4, 5, 6]
frequencies = [18, 16, 18, 17, 18, 13]

chart = pygal.Bar()
chart.force_uri_protocol = 'http'
chart.x_labels = outcomes
chart.add('D6', frequencies)
chart.render_to_file('rolling_dice.svg')
```

### Making a bar graph from a dictionary

Since each bar needs a label and a value, a dictionary is a great way to store the data for a bar graph. The keys are used as the labels along the x-axis, and the values are used to determine the height of each bar.

```
import pygal

results = {
    1:18, 2:16, 3:18,
    4:17, 5:18, 6:13,
}

chart = pygal.Bar()
chart.force_uri_protocol = 'http'
chart.x_labels = results.keys()
chart.add('D6', results.values())
chart.render_to_file('rolling_dice.svg')
```

## Multiple plots

You can add as much data as you want when making a visualization.

### Plotting squares and cubes

```
import pygal

x_values = list(range(11))
squares = [x**2 for x in x_values]
cubes = [x**3 for x in x_values]

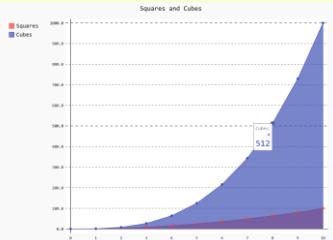
chart = pygal.Line()
chart.force_uri_protocol = 'http'
chart.title = "Squares and Cubes"
chart.x_labels = x_values

chart.add('Squares', squares)
chart.add('Cubes', cubes)
chart.render_to_file('squares_cubes.svg')
```

### Filling the area under a data series

Pygal allows you to fill the area under or over each series of data. The default is to fill from the x-axis up, but you can fill from any horizontal line using the `zero` argument.

```
chart = pygal.Line(fill=True, zero=0)
```



## Online resources

The documentation for Pygal is available at <http://www.pygal.org/>.

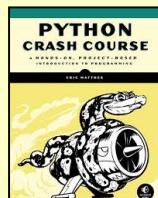
## Enabling interactive features

If you're viewing svg output in a browser, Pygal needs to render the output file in a specific way. The `force_uri_protocol` attribute for `chart` objects needs to be set to 'http'.

## Python Crash Course

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## Styling plots

Pygal lets you customize many elements of a plot. There are some excellent default themes, and many options for styling individual plot elements.

### Using built-in styles

To use built-in styles, import the style and make an instance of the style class. Then pass the style object with the style argument when you make the chart object.

```
import pygal
from pygal.style import LightGreenStyle

x_values = list(range(11))
squares = [x**2 for x in x_values]
cubes = [x**3 for x in x_values]

chart_style = LightGreenStyle()
chart = pygal.Line(style=chart_style)
chart.force_uri_protocol = 'http'
chart.title = "Squares and Cubes"
chart.x_labels = x_values

chart.add('Squares', squares)
chart.add('Cubes', cubes)
chart.render_to_file('squares_cubes.svg')
```

### Parametric built-in styles

Some built-in styles accept a custom color, then generate a theme based on that color.

```
from pygal.style import LightenStyle

--snip--
chart_style = LightenStyle('#336688')
chart = pygal.Line(style=chart_style)
--snip--
```

### Customizing individual style properties

Style objects have a number of properties you can set individually.

```
chart_style = LightenStyle('#336688')
chart_style.plot_background = '#CCCCCC'
chart_style.major_label_font_size = 20
chart_style.label_font_size = 16
--snip--
```

### Custom style class

You can start with a bare style class, and then set only the properties you care about.

```
chart_style = Style()
chart_style.colors = [
    '#CCCCCC', '#AAAAAA', '#888888']
chart_style.plot_background = '#EEEEEE'

chart = pygal.Line(style=chart_style)
--snip--
```

## Styling plots (cont.)

### Configuration settings

Some settings are controlled by a Config object.

```
my_config = pygal.Config()
my_config.show_y_guides = False
my_config.width = 1000
my_config.dots_size = 5

chart = pygal.Line(config=my_config)
--snip--
```

### Styling series

You can give each series on a chart different style settings.

```
chart.add('Squares', squares, dots_size=2)
chart.add('Cubes', cubes, dots_size=3)
```

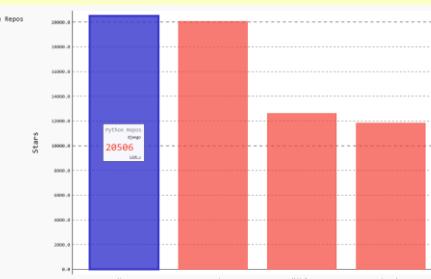
### Styling individual data points

You can style individual data points as well. To do so, write a dictionary for each data point you want to customize. A 'value' key is required, and other properties are optional.

```
import pygal

repos = [
    {
        'value': 20506,
        'color': '#3333CC',
        'xlink': 'http://djangoproject.com/',
    },
    20054,
    12607,
    11827,
]
```

```
chart = pygal.Bar()
chart.force_uri_protocol = 'http'
chart.x_labels = [
    'django', 'requests', 'scikit-learn',
    'tornado',
]
chart.y_title = 'Stars'
chart.add('Python Repos', repos)
chart.render_to_file('python_repos.svg')
```



## Plotting global datasets

Pygal can generate world maps, and you can add any data you want to these maps. Data is indicated by coloring, by labels, and by tooltips that show data when users hover over each country on the map.

### Installing the world map module

The world map module is not included by default in Pygal 2.0. It can be installed with pip:

```
$ pip install --user pygal_maps_world
```

### Making a world map

The following code makes a simple world map showing the countries of North America.

```
from pygal.maps.world import World
```

```
wm = World()
wm.force_uri_protocol = 'http'
wm.title = 'North America'
wm.add('North America', ['ca', 'mx', 'us'])

wm.render_to_file('north_america.svg')
```

### Showing all the country codes

In order to make maps, you need to know Pygal's country codes. The following example will print an alphabetical list of each country and its code.

```
from pygal.maps.world import COUNTRIES

for code in sorted(COUNTRIES.keys()):
    print(code, COUNTRIES[code])
```

### Plotting numerical data on a world map

To plot numerical data on a map, pass a dictionary to add() instead of a list.

```
from pygal.maps.world import World

populations = {
    'ca': 34126000,
    'us': 309349000,
    'mx': 113423000,
}
```

```
wm = World()
wm.force_uri_protocol = 'http'
wm.title = 'Population of North America'
wm.add('North America', populations)
```

```
wm.render_to_file('na_populations.svg')
```

[More cheat sheets available at  
ehmatthes.github.io/pcc/](https://ehmatthes.github.io/pcc/)

# Beginner's Python Cheat Sheet — Django

## What is Django?

Django is a web framework which helps you build interactive websites using Python. With Django you define the kind of data your site needs to work with, and you define the ways your users can work with that data.

## Installing Django

It's usually best to install Django to a virtual environment, where your project can be isolated from your other Python projects. Most commands assume you're working in an active virtual environment.

### Create a virtual environment

```
$ python -m venv ll_env
```

### Activate the environment (Linux and OS X)

```
$ source ll_env/bin/activate
```

### Activate the environment (Windows)

```
> ll_env\Scripts\activate
```

### Install Django to the active environment

```
(ll_env)$ pip install Django
```

## Creating a project

To start a project we'll create a new project, create a database, and start a development server.

### Create a new project

```
$ django-admin.py startproject learning_log .
```

### Create a database

```
$ python manage.py migrate
```

### View the project

After issuing this command, you can view the project at <http://localhost:8000/>.

```
$ python manage.py runserver
```

### Create a new app

A Django project is made up of one or more apps.

```
$ python manage.py startapp learning_logs
```

## Working with models

The data in a Django project is structured as a set of models.

### Defining a model

To define the models for your app, modify the file `models.py` that was created in your app's folder. The `__str__()` method tells Django how to represent data objects based on this model.

```
from django.db import models

class Topic(models.Model):
    """A topic the user is learning about."""
    text = models.CharField(max_length=200)
    date_added = models.DateTimeField(auto_now_add=True)

    def __str__(self):
        return self.text
```

### Activating a model

To use a model the app must be added to the tuple `INSTALLED_APPS`, which is stored in the project's `settings.py` file.

```
INSTALLED_APPS = (
    --snip--
    'django.contrib.staticfiles',

    # My apps
    'learning_logs',
)
```

### Migrating the database

The database needs to be modified to store the kind of data that the model represents.

```
$ python manage.py makemigrations learning_logs
$ python manage.py migrate
```

### Creating a superuser

A superuser is a user account that has access to all aspects of the project.

```
$ python manage.py createsuperuser
```

### Registering a model

You can register your models with Django's admin site, which makes it easier to work with the data in your project. To do this, modify the app's `admin.py` file. View the admin site at <http://localhost:8000/admin/>.

```
from django.contrib import admin

from learning_logs.models import Topic

admin.site.register(Topic)
```

## Building a simple home page

Users interact with a project through web pages, and a project's home page can start out as a simple page with no data. A page usually needs a URL, a view, and a template.

### Mapping a project's URLs

The project's main `urls.py` file tells Django where to find the `urls.py` files associated with each app in the project.

```
from django.conf.urls import include, url
from django.contrib import admin

urlpatterns = [
    url(r'^admin/', include(admin.site.urls)),
    url(r'', include('learning_logs.urls'),
        namespace='learning_logs'),
```

### Mapping an app's URLs

An app's `urls.py` file tells Django which view to use for each URL in the app. You'll need to make this file yourself, and save it in the app's folder.

```
from django.conf.urls import url

from . import views

urlpatterns = [
    url(r'^$', views.index, name='index'),
```

### Writing a simple view

A view takes information from a request and sends data to the browser, often through a template. View functions are stored in an app's `views.py` file. This simple view function doesn't pull in any data, but it uses the template `index.html` to render the home page.

```
from django.shortcuts import render

def index(request):
    """The home page for Learning Log."""
    return render(request,
                  'learning_logs/index.html')
```

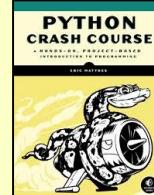
## Online resources

The documentation for Django is available at <http://docs.djangoproject.com/>. The Django documentation is thorough and user-friendly, so check it out!

## Python Crash Course

Covers Python 3 and Python 2

[nostarchpress.com/pythoncrashcourse](http://nostarchpress.com/pythoncrashcourse)



## Building a simple home page (cont.)

### Writing a simple template

A template sets up the structure for a page. It's a mix of html and template code, which is like Python but not as powerful. Make a folder called `templates` inside the project folder. Inside the `templates` folder make another folder with the same name as the app. This is where the template files should be saved.

```
<p>Learning Log</p>
```

```
<p>Learning Log helps you keep track of your learning, for any topic you're learning about.</p>
```

### Template inheritance

Many elements of a web page are repeated on every page in the site, or every page in a section of the site. By writing one parent template for the site, and one for each section, you can easily modify the look and feel of your entire site.

#### The parent template

The parent template defines the elements common to a set of pages, and defines blocks that will be filled by individual pages.

```
<p>
  <a href="{% url 'learning_logs:index' %}">
    Learning Log
  </a>
</p>

{% block content %}{% endblock content %}
```

#### The child template

The child template uses the `{% extends %}` template tag to pull in the structure of the parent template. It then defines the content for any blocks defined in the parent template.

```
{% extends 'learning_logs/base.html' %}

{% block content %}
  <p>
    Learning Log helps you keep track
    of your learning, for any topic you're
    learning about.
  </p>
{% endblock content %}
```

### Template indentation

Python code is usually indented by four spaces. In templates you'll often see two spaces used for indentation, because elements tend to be nested more deeply in templates.

## Another model

A new model can use an existing model. The `ForeignKey` attribute establishes a connection between instances of the two related models. Make sure to migrate the database after adding a new model to your app.

### Defining a model with a foreign key

```
class Entry(models.Model):
    """Learning log entries for a topic."""
    topic = models.ForeignKey(Topic)
    text = models.TextField()
    date_added = models.DateTimeField(
        auto_now_add=True)

    def __str__(self):
        return self.text[:50] + "..."
```

## Building a page with data

Most pages in a project need to present data that's specific to the current user.

#### URL parameters

A URL often needs to accept a parameter telling it which data to access from the database. The second URL pattern shown here looks for the ID of a specific topic and stores it in the parameter `topic_id`.

```
urlpatterns = [
    url(r'^$', views.index, name='index'),
    url(r'^topics/(?P<topic_id>\d+)/$', views.topic, name='topic'),
]
```

#### Using data in a view

The view uses a parameter from the URL to pull the correct data from the database. In this example the view is sending a context dictionary to the template, containing data that should be displayed on the page.

```
def topic(request, topic_id):
    """Show a topic and all its entries."""
    topic = Topic.objects.get(id=topic_id)
    entries = topic.entry_set.order_by(
        '-date_added')
    context = {
        'topic': topic,
        'entries': entries,
    }
    return render(request,
        'learning_logs/topic.html', context)
```

## Restarting the development server

If you make a change to your project and the change doesn't seem to have any effect, try restarting the server:  
`$ python manage.py runserver`

## Building a page with data (cont.)

### Using data in a template

The data in the view function's context dictionary is available within the template. This data is accessed using template variables, which are indicated by doubled curly braces.

The vertical line after a template variable indicates a filter. In this case a filter called `date` formats date objects, and the filter `linebreaks` renders paragraphs properly on a web page.

```
{% extends 'learning_logs/base.html' %}
```

```
{% block content %}
```

```
<p>Topic: {{ topic }}</p>
```

```
<p>Entries:</p>
```

```
<ul>
```

```
{% for entry in entries %}
```

```
<li>
```

```
  {{ entry.date_added|date:'M d, Y H:i' }}
```

```
</p>
```

```
<p>
```

```
  {{ entry.text|linebreaks }}
```

```
</p>
```

```
</li>
```

```
{% empty %}
```

```
<li>There are no entries yet.</li>
```

```
{% endfor %}
```

```
</ul>
```

```
{% endblock content %}
```

## The Django shell

You can explore the data in your project from the command line. This is helpful for developing queries and testing code snippets.

### Start a shell session

```
$ python manage.py shell
```

### Access data from the project

```
>>> from learning_logs.models import Topic
>>> Topic.objects.all()
[<Topic: Chess>, <Topic: Rock Climbing>]
>>> topic = Topic.objects.get(id=1)
>>> topic.text
'Chess'
```

More cheat sheets available at  
[ehmatthes.github.io/pcc/](https://ehmatthes.github.io/pcc/)

# Beginner's Python Cheat Sheet — Django, Part 2

## Users and forms

Most web applications need to let users create accounts. This lets users create and work with their own data. Some of this data may be private, and some may be public. Django's forms allow users to enter and modify their data.

## User accounts

User accounts are handled by a dedicated app called `users`. Users need to be able to register, log in, and log out. Django automates much of this work for you.

### Making a users app

After making the app, be sure to add '`users`' to `INSTALLED_APPS` in the project's `settings.py` file.

```
$ python manage.py startapp users
```

### Including URLs for the users app

Add a line to the project's `urls.py` file so the `users` app's URLs are included in the project.

```
urlpatterns = [
    url(r'^admin/', include(admin.site.urls)),
    url(r'^users/', include('users.urls',
                           namespace='users')),
    url(r'', include('learning_logs.urls',
                     namespace='learning_logs')),
]
```

## Using forms in Django

There are a number of ways to create forms and work with them. You can use Django's defaults, or completely customize your forms. For a simple way to let users enter data based on your models, use a `ModelForm`. This creates a form that allows users to enter data that will populate the fields on a model.

The `register` view on the back of this sheet shows a simple approach to form processing. If the view doesn't receive data from a form, it responds with a blank form. If it receives POST data from a form, it validates the data and then saves it to the database.

## User accounts (cont.)

### Defining the URLs

Users will need to be able to log in, log out, and register. Make a new `urls.py` file in the `users` app folder. The `login` view is a default view provided by Django.

```
from django.conf.urls import url
from django.contrib.auth.views import login

from . import views

urlpatterns = [
    url(r'^login/$', login,
        {'template_name': 'users/login.html'},
        name='login'),
    url(r'^logout/$', views.logout_view,
        name='logout'),
    url(r'^register/$', views.register,
        name='register'),
]
```

### The login template

The `login` view is provided by default, but you need to provide your own login template. The template shown here displays a simple login form, and provides basic error messages. Make a `templates` folder in the `users` folder, and then make a `users` folder in the `templates` folder. Save this file as `login.html`.

The tag `{% csrf_token %}` helps prevent a common type of attack with forms. The `{{ form.as_p }}` element displays the default login form in paragraph format. The `<input>` element named `next` redirects the user to the home page after a successful login.

```
{% extends "learning_logs/base.html" %}

{% block content %}
    {% if form.errors %}
        <p>
            Your username and password didn't match.
            Please try again.
        </p>
    {% endif %}

    <form method="post"
          action="{% url 'users:login' %}">
        {% csrf_token %}
        {{ form.as_p }}
        <button name="submit">log in</button>

        <input type="hidden" name="next"
              value="{% url 'learning_logs:index' %}" />
    </form>

    {% endblock content %}
```

## User accounts (cont.)

### Showing the current login status

You can modify the `base.html` template to show whether the user is currently logged in, and to provide a link to the login and logout pages. Django makes a `user` object available to every template, and this template takes advantage of this object.

The `user.is_authenticated` tag allows you to serve specific content to users depending on whether they have logged in or not. The `{{ user.username }}` property allows you to greet users who have logged in. Users who haven't logged in see links to register or log in.

```
<p>
    <a href="{% url 'learning_logs:index' %}">
        Learning Log
    </a>
    {% if user.is_authenticated %}
        Hello, {{ user.username }}.
        <a href="{% url 'users:logout' %}">
            log out
        </a>
    {% else %}
        <a href="{% url 'users:register' %}">
            register
        </a> -
        <a href="{% url 'users:login' %}">
            log in
        </a>
    {% endif %}
</p>

{% block content %}{% endblock content %}
```

### The logout view

The `logout_view()` function uses Django's `logout()` function and then redirects the user back to the home page. Since there is no logout page, there is no logout template. Make sure to write this code in the `views.py` file that's stored in the `users` app folder.

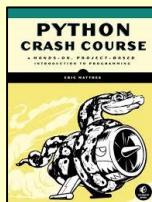
```
from django.http import HttpResponseRedirect
from django.core.urlresolvers import reverse
from django.contrib.auth import logout

def logout_view(request):
    """Log the user out."""
    logout(request)
    return HttpResponseRedirect(
        reverse('learning_logs:index'))
```

## Python Crash Course

Covers Python 3 and Python 2

[nostarchpress.com/pythoncrashcourse](http://nostarchpress.com/pythoncrashcourse)



## User accounts (cont.)

### The register view

The register view needs to display a blank registration form when the page is first requested, and then process completed registration forms. A successful registration logs the user in and redirects to the home page.

```
from django.contrib.auth import login
from django.contrib.auth import authenticate
from django.contrib.auth.forms import \
    UserCreationForm

def register(request):
    """Register a new user."""
    if request.method != 'POST':
        # Show blank registration form.
        form = UserCreationForm()
    else:
        # Process completed form.
        form = UserCreationForm(
            data=request.POST)

    if form.is_valid():
        new_user = form.save()
        # Log in, redirect to home page.
        pw = request.POST['password1']
        authenticated_user = authenticate(
            username=new_user.username,
            password=pw)
        login(request, authenticated_user)
        return HttpResponseRedirect(
            reverse('learning_logs:index'))

    context = {'form': form}
    return render(request,
                  'users/register.html', context)
```

## Styling your project

The django-bootstrap3 app allows you to use the Bootstrap library to make your project look visually appealing. The app provides tags that you can use in your templates to style individual elements on a page. Learn more at <http://django-bootstrap3.readthedocs.io/>.

## Deploying your project

Heroku lets you push your project to a live server, making it available to anyone with an internet connection. Heroku offers a free service level, which lets you learn the deployment process without any commitment. You'll need to install a set of heroku tools, and use git to track the state of your project. See <http://devcenter.heroku.com/>, and click on the Python link.

## User accounts (cont.)

### The register template

The register template displays the registration form in paragraph formats.

```
{% extends 'learning_logs/base.html' %}

{% block content %}

<form method='post'
      action="{% url 'users:register' %}>

    {% csrf_token %}
    {{ form.as_p }}

    <button name='submit'>register</button>
    <input type='hidden' name='next'
           value="{% url 'learning_logs:index' %}" />

</form>

{% endblock content %}
```

## Connecting data to users

Users will have data that belongs to them. Any model that should be connected directly to a user needs a field connecting instances of the model to a specific user.

### Making a topic belong to a user

Only the highest-level data in a hierarchy needs to be directly connected to a user. To do this import the User model, and add it as a foreign key on the data model.

After modifying the model you'll need to migrate the database. You'll need to choose a user ID to connect each existing instance to.

```
from django.db import models
from django.contrib.auth.models import User

class Topic(models.Model):
    """A topic the user is learning about."""
    text = models.CharField(max_length=200)
    date_added = models.DateTimeField(
        auto_now_add=True)
    owner = models.ForeignKey(User)

    def __str__(self):
        return self.text
```

### Querying data for the current user

In a view, the request object has a user attribute. You can use this attribute to query for the user's data. The filter() function then pulls the data that belongs to the current user.

```
topics = Topic.objects.filter(
    owner=request.user)
```

## Connecting data to users (cont.)

### Restricting access to logged-in users

Some pages are only relevant to registered users. The views for these pages can be protected by the @login\_required decorator. Any view with this decorator will automatically redirect non-logged in users to an appropriate page. Here's an example views.py file.

```
from django.contrib.auth.decorators import /
    login_required
--snip--

@login_required
def topic(request, topic_id):
    """Show a topic and all its entries."""


```

### Setting the redirect URL

The @login\_required decorator sends unauthorized users to the login page. Add the following line to your project's settings.py file so Django will know how to find your login page.

```
LOGIN_URL = '/users/login/'
```

### Preventing inadvertent access

Some pages serve data based on a parameter in the URL. You can check that the current user owns the requested data, and return a 404 error if they don't. Here's an example view.

```
from django.http import Http404
--snip--
def topic(request, topic_id):
    """Show a topic and all its entries."""
    topic = Topics.objects.get(id=topic_id)
    if topic.owner != request.user:
        raise Http404
--snip--
```

## Using a form to edit data

If you provide some initial data, Django generates a form with the user's existing data. Users can then modify and save their data.

### Creating a form with initial data

The instance parameter allows you to specify initial data for a form.

```
form = EntryForm(instance=entry)
```

### Modifying data before saving

The argument commit=False allows you to make changes before writing data to the database.

```
new_topic = form.save(commit=False)
new_topic.owner = request.user
new_topic.save()
```

More cheat sheets available at  
[ehmatthes.github.io/pcc/](https://ehmatthes.github.io/pcc/)

# Dictionaries

## Accessing and writing data in a Python dictionary

Values in a Python dictionary can be accessed by placing the key within square brackets next to the dictionary.

Values can be written by placing key within square brackets next to the dictionary and using the assignment operator ( = ). If the key already exists, the old value will be overwritten. Attempting to access a value with a key that does not exist will cause a `KeyError`.

To illustrate this review card, the second line of the example code block shows the way to access the value using the key "song". The third line of the code block overwrites the value that corresponds to the key "song".

```
my_dictionary = {"song": "Estranged",
"artist": "Guns N' Roses"}
print(my_dictionary["song"])
my_dictionary["song"] = "Paradise City"
```

## Syntax of the Python dictionary

The syntax for a Python dictionary begins with the left curly brace ( { ), ends with the right curly brace ( } ), and contains zero or more `key : value` items separated by commas ( , ). The `key` is separated from the `value` by a colon ( : ).

```
roaster = {"q1": "Ashley", "q2": "Dolly"}
```

## Merging dictionaries with the `.update()` method in Python

Given two dictionaries that need to be combined, Python makes this easy with the `.update()` function.

For `dict1.update(dict2)`, the key-value pairs of `dict2` will be written into the `dict1` dictionary.

For keys in *both* `dict1` and `dict2`, the value in `dict1` will be overwritten by the corresponding value in `dict2`.

```
dict1 = {'color': 'blue', 'shape':
'circle'}
dict2 = {'color': 'red', 'number': 42}
```

```
dict1.update(dict2)
```

```
# dict1 is now {'color': 'red', 'shape':
'circle', 'number': 42}
```

## Dictionary value types

Python allows the *values* in a dictionary to be any type – string, integer, a list, another dictionary, boolean, etc.

However, *keys* must always be an immutable data type, such as strings, numbers, or tuples.

In the example code block, you can see that the keys are strings or numbers (int or float). The values, on the other hand, are many varied data types.

```
dictionary = {
1: 'hello',
'two': True,
'3': [1, 2, 3],
'Four': {'fun': 'addition'},
5.0: 5.5
}
```

## Python dictionaries

A python dictionary is an unordered collection of items. It contains data as a set of key: value pairs.

```
my_dictionary = {1: "L.A. Lakers", 2: "Houston Rockets"}
```

## Dictionary Key-Value Methods

When trying to look at the information in a Python dictionary, there are multiple methods that return objects that contain the dictionary keys and values.

.keys() returns the keys through a dict\_keys object.

```
.values() returns the values through a dict_values object.
```

```
.items() returns both the keys and values through a dict_items object.
```

```
ex_dict = {"a": "anteater", "b": "bumblebee", "c": "cheetah"}
```

```
ex_dict.keys()  
# dict_keys(["a", "b", "c"])
```

```
ex_dict.values()  
# dict_values(["anteater", "bumblebee",  
"cheetah"])
```

```
ex_dict.items()  
# dict_items([("a", "anteater"),  
("b", "bumblebee"), ("c", "cheetah")])
```

## get() Method for Dictionary

Python provides a .get() method to access a dictionary value if it exists. This method takes the key as the first argument and an optional default value as the second argument, and it returns the value for the specified key if key is in the dictionary. If the second argument is not specified and key is not found then None is returned.

```
# without default  
{"name": "Victor"}.get("name")  
# returns "Victor"
```

```
{"name": "Victor"}.get("nickname")  
# returns None
```

```
# with default  
{"name": "Victor"}.get("nickname",  
"nickname is not a key")  
# returns "nickname is not a key"
```

## The `.pop()` Method for Dictionaries in Python

Python dictionaries can remove key-value pairs with the `.pop()` method. The method takes a key as an argument and removes it from the dictionary. At the same time, it also returns the value that it removes from the dictionary.

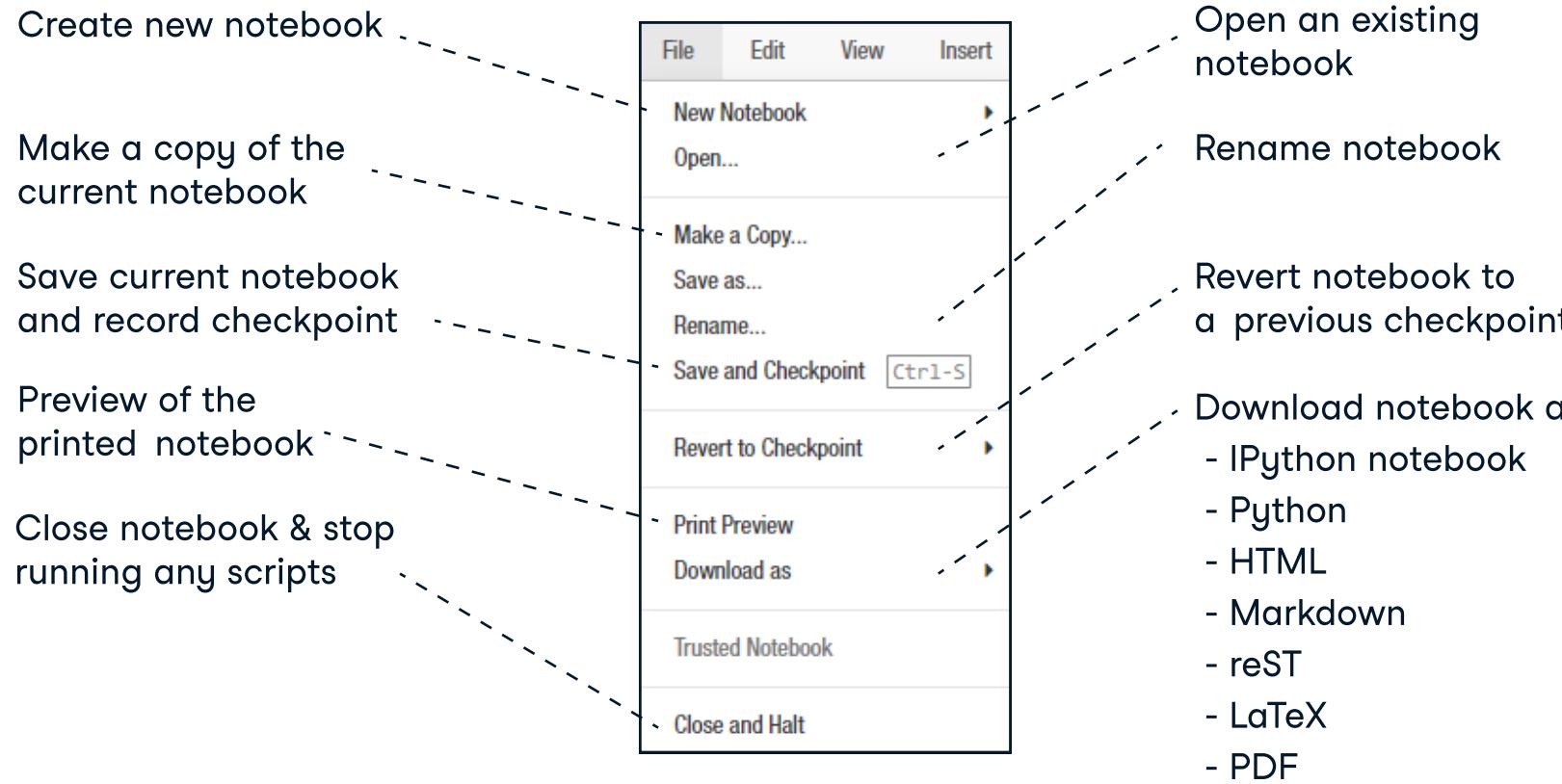
```
famous_museums = {'Washington':  
    'Smithsonian Institution', 'Paris': 'Le  
    Louvre', 'Athens': 'The Acropolis Museum'}  
famous_museums.pop('Athens')  
print(famous_museums) # {'Washington':  
    'Smithsonian Institution', 'Paris': 'Le  
    Louvre'}
```

# Python For Data Science

## Jupyter Cheat Sheet

Learn Jupyter online at [www.DataCamp.com](http://www.DataCamp.com)

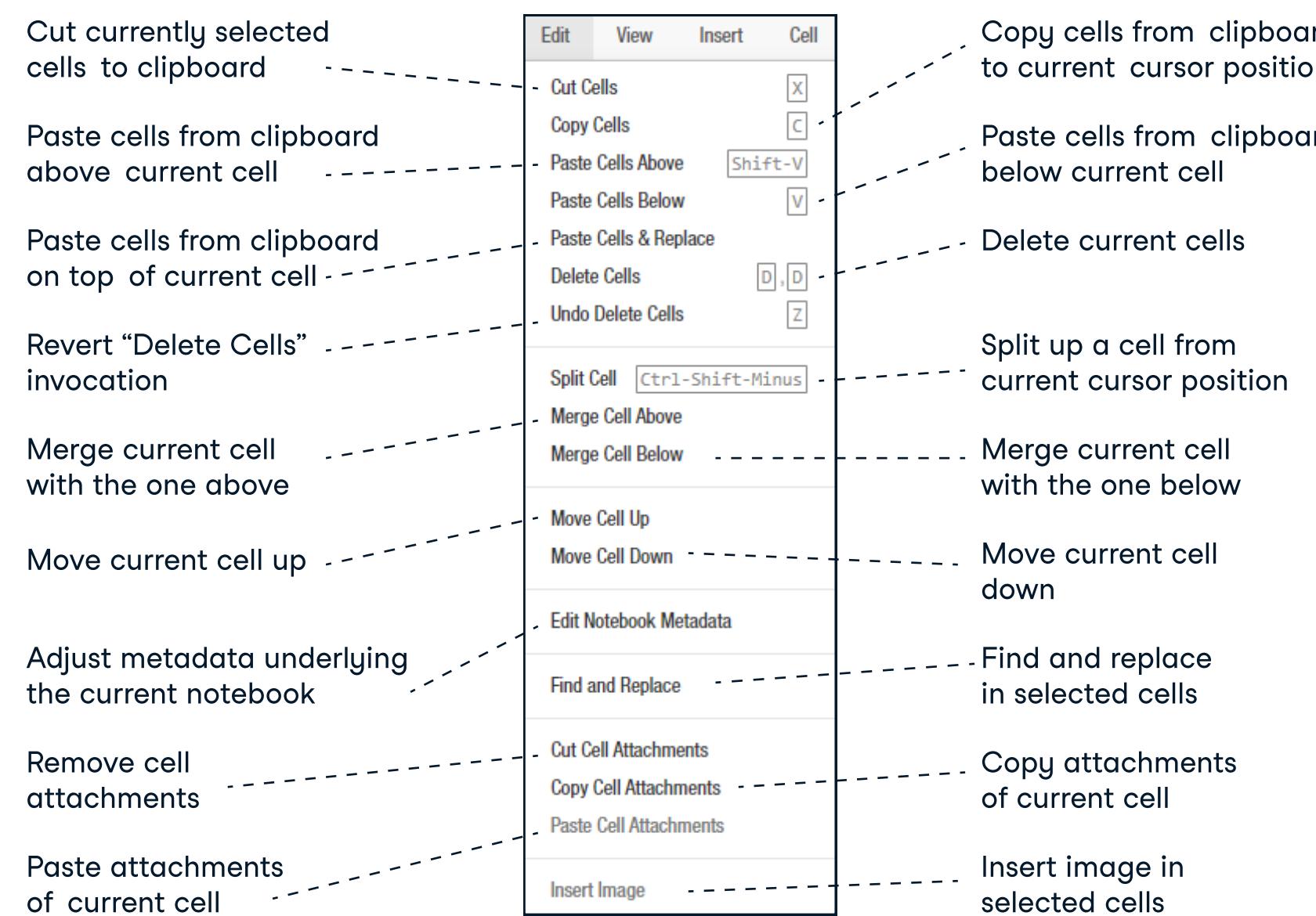
### > Saving/Loading Notebooks



### > Writing Code And Text

Code and text are encapsulated by 3 basic cell types: markdown cells, code cells, and raw NBConvert cells

#### Edit Cells



#### Insert Cells



### > Working with Different Programming Languages

Kernels provide computation and communication with front-end interfaces like the notebooks.  
There are three main kernels:

IP[y]:



IPython

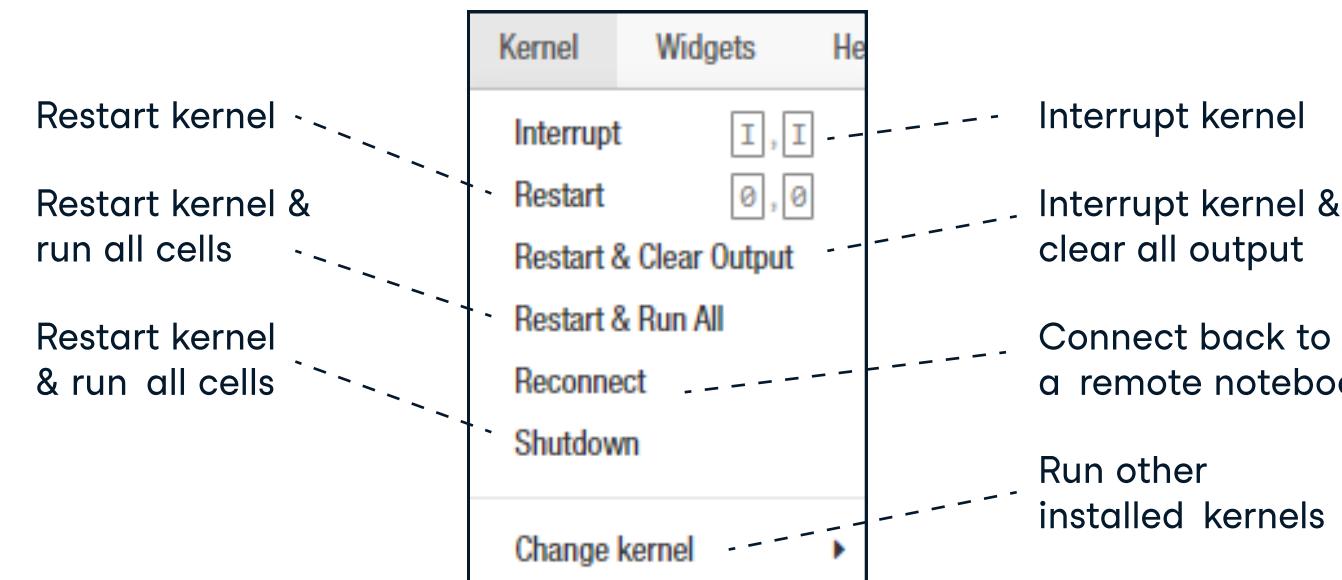


IRkernel

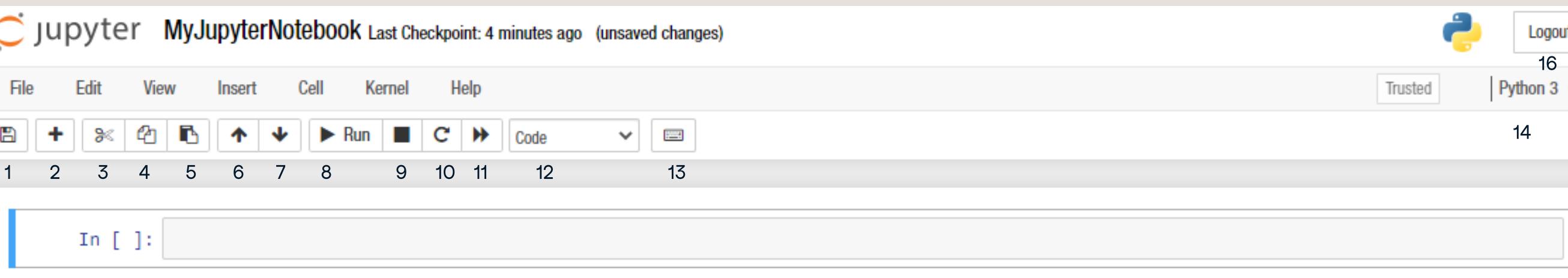


IJulia

Installing Jupyter Notebook will automatically install the IPython kernel.



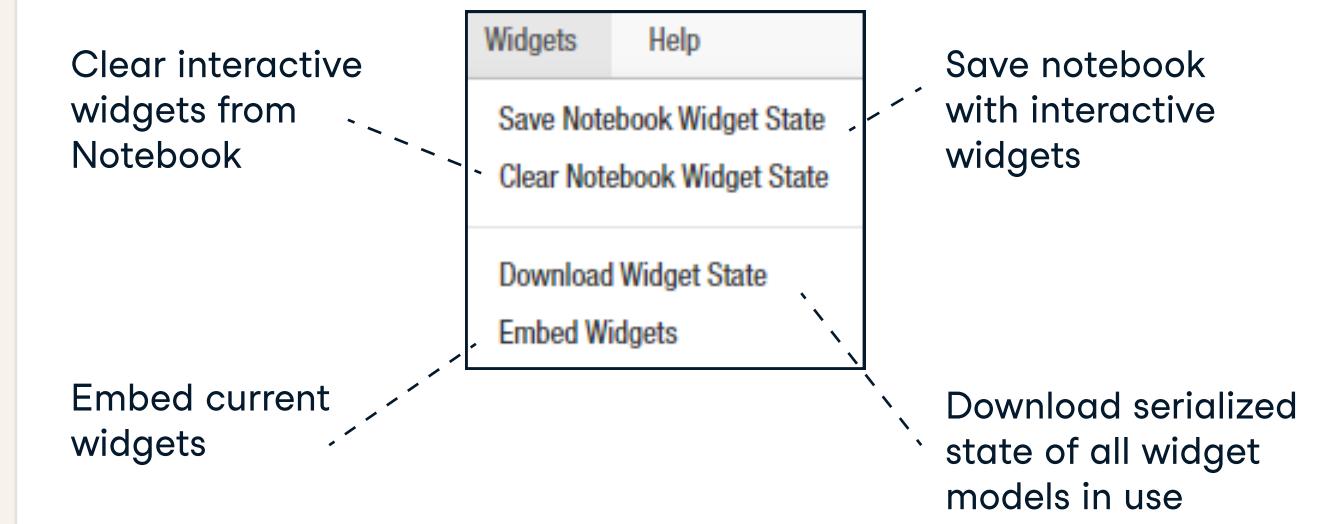
#### Command Mode:



### > Widgets

Notebook widgets provide the ability to visualize and control changes in your data, often as a control like a slider, textbox, etc.

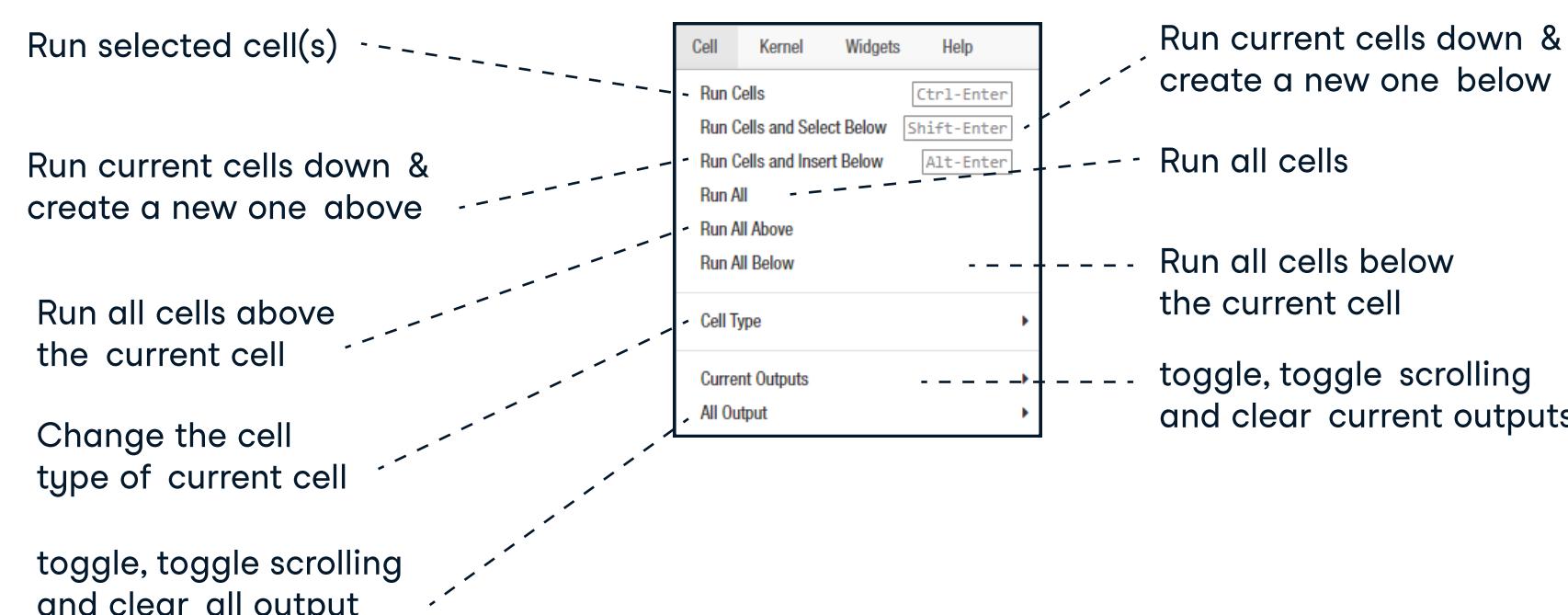
You can use them to build interactive GUIs for your notebooks or to synchronize stateful and stateless information between Python and JavaScript.



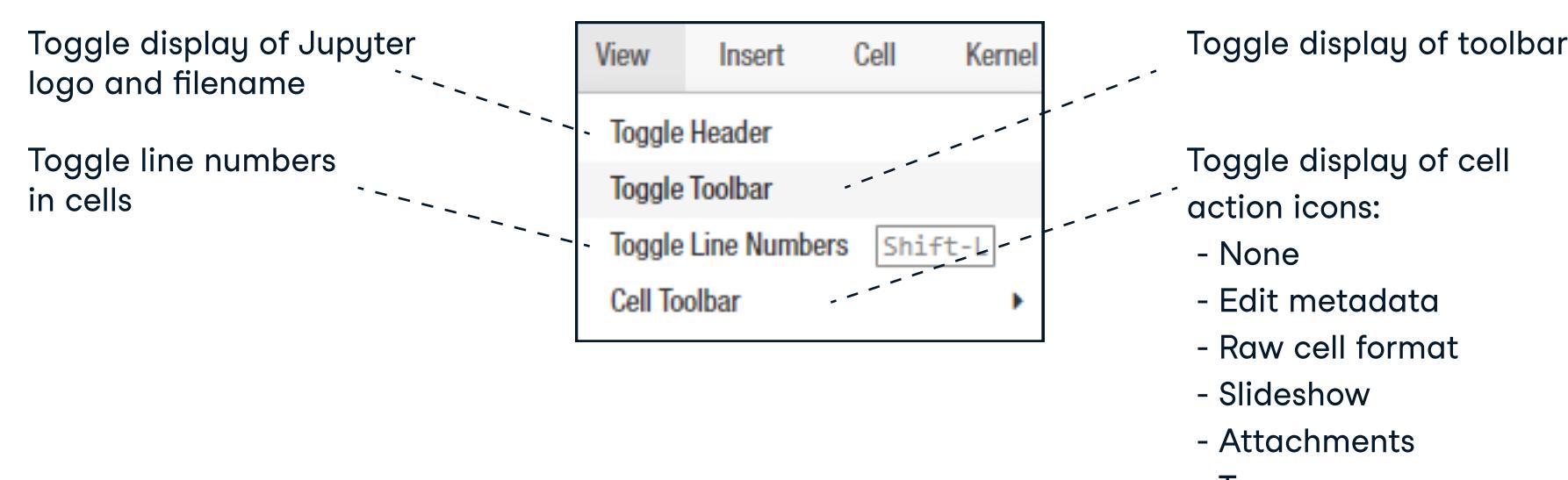
#### Edit Mode:

In [ ]: |

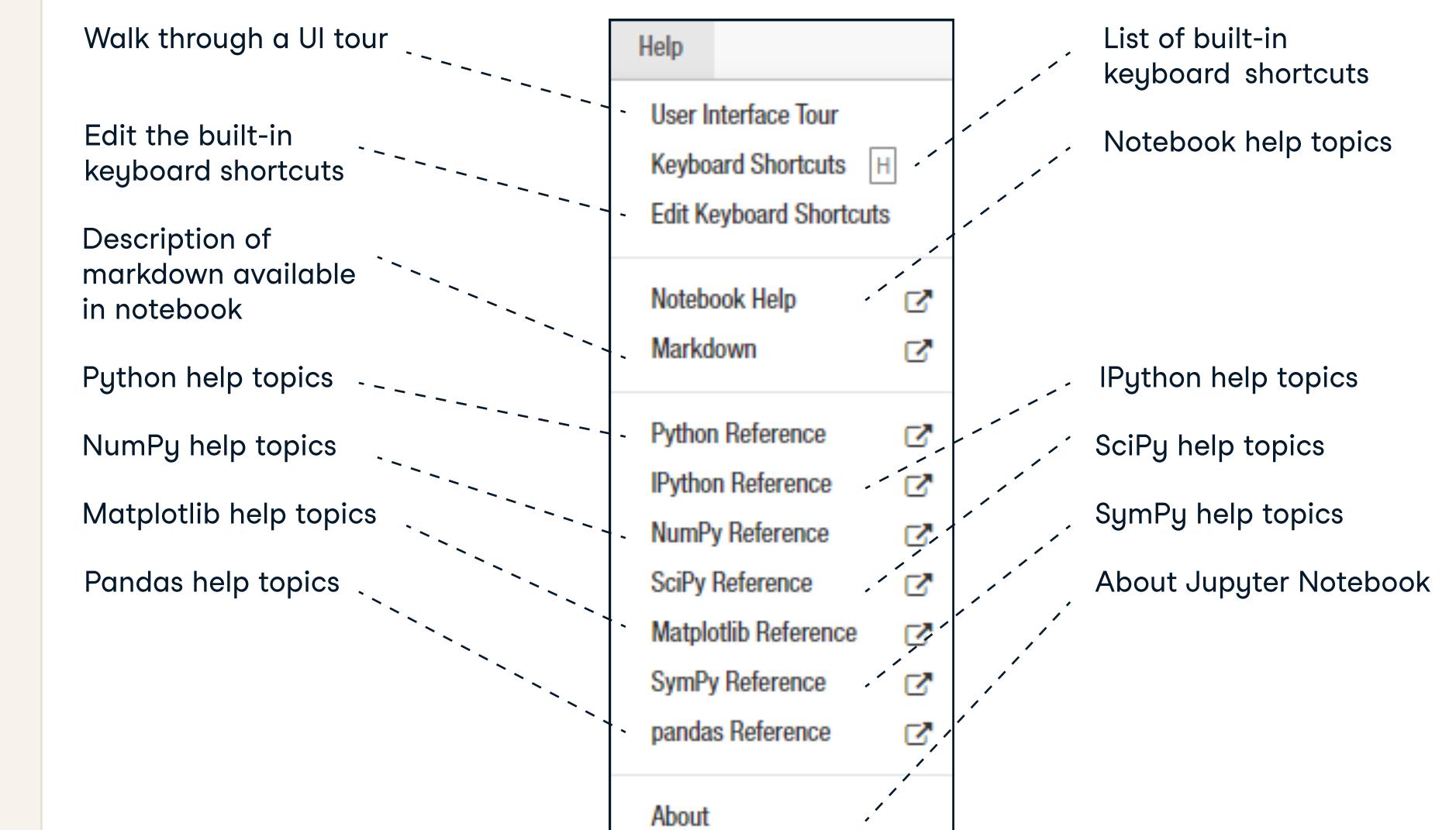
#### Executing Cells



#### View Cells



#### Asking For Help



Learn Data Skills Online at [www.DataCamp.com](http://www.DataCamp.com)

# LATEX 2\epsilon Cheat Sheet

## Document classes

book	Default is two-sided.
report	No <code>\part</code> divisions.
article	No <code>\part</code> or <code>\chapter</code> divisions.
letter	Letter (?).
slides	Large sans-serif font.

Used at the very beginning of a document:

`\documentclass{class}`. Use `\begin{document}` to start contents and `\end{document}` to end the document.

## Common documentclass options

10pt/11pt/12pt	Font size.
letterpaper/a4paper	Paper size.
twocolumn	Use two columns.
twoside	Set margins for two-sided.
landscape	Landscape orientation. Must use dvips -t landscape.
draft	Double-space lines.

Usage: `\documentclass[opt,opt]{class}`.

## Packages

fullpage	Use 1 inch margins.
anysize	Set margins: <code>\marginsize{l}{r}{t}{b}</code> .
multicol	Use <i>n</i> columns: <code>\begin{multicols}{n}</code> .
latextsym	Use L <small>A</small> T <small>E</small> X symbol font.
graphicx	Show image: <code>\includegraphics[width=x]{file}</code> .
url	Insert URL: <code>\url{http://...}</code> .

Use before `\begin{document}`. Usage: `\usepackage{package}`

## Title

`\author{text}` Author of document.

`\title{text}` Title of document.

`\date{text}` Date.

These commands go before `\begin{document}`. The declaration `\maketitle` goes at the top of the document.

## Miscellaneous

`\pagestyle{empty}` Empty header, footer and no page numbers.

`\tableofcontents` Add a table of contents here.

## Document structure

<code>\part{title}</code>	<code>\subsubsection{title}</code>
<code>\chapter{title}</code>	<code>\paragraph{title}</code>
<code>\section{title}</code>	<code>\subparagraph{title}</code>
<code>\subsection{title}</code>	

Use `\setcounter{secnumdepth}{x}` suppresses heading numbers of depth  $> x$ , where `chapter` has depth 0. Use a \*, as in `\section*{title}`, to not number a particular item—these items will also not appear in the table of contents.

## Text environments

<code>\begin{comment}</code>	Comment (not printed). Requires <code>verbatim</code> package.
<code>\begin{quote}</code>	Indented quotation block.
<code>\begin{quotation}</code>	Like <code>quote</code> with indented paragraphs.
<code>\begin{verse}</code>	Quotation block for verse.

## Lists

<code>\begin{enumerate}</code>	Numbered list.
<code>\begin{itemize}</code>	Bulleted list.
<code>\begin{description}</code>	Description list.
<code>\item text</code>	Add an item.
<code>\item[x] text</code>	Use <i>x</i> instead of normal bullet or number.

Required for descriptions.

## References

<code>\label{marker}</code>	Set a marker for cross-reference, often of the form <code>\label{sec:item}</code> .
<code>\ref{marker}</code>	Give section/body number of marker.
<code>\pageref{marker}</code>	Give page number of marker.
<code>\footnote{text}</code>	Print footnote at bottom of page.

## Floating bodies

<code>\begin{table}[place]</code>	Add numbered table.
<code>\begin{figure}[place]</code>	Add numbered figure.
<code>\begin{equation}[place]</code>	Add numbered equation.
<code>\caption{text}</code>	Caption for the body.

The *place* is a list valid placements for the body. t=top, h=here, b=bottom, p=separate page, !=place even if ugly. Captions and label markers should be within the environment.

## Text properties

### Font face

Command	Declaration	Effect
<code>\textrm{text}</code>	<code>\rmfamily text</code>	Roman family
<code>\textsf{text}</code>	<code>\sffamily text</code>	Sans serif family
<code>\texttt{text}</code>	<code>\ttfamily text</code>	Typewriter family
<code>\textmd{text}</code>	<code>\mdseries text</code>	Medium series
<code>\textbf{text}</code>	<code>\bfseries text</code>	<b>Bold series</b>
<code>\textup{text}</code>	<code>\upshape text</code>	Upright shape
<code>\textit{text}</code>	<code>\itshape text</code>	<i>Italic shape</i>
<code>\textsl{text}</code>	<code>\slshape text</code>	Slanted shape
<code>\textsc{text}</code>	<code>\scshape text</code>	SMALL CAPS SHAPE
<code>\emph{text}</code>	<code>\em text</code>	Emphasized
<code>\textnormal{text}</code>	<code>\normalfont text</code>	Document font
<code>\underline{text}</code>		<u>Underline</u>

The command (ttt) form handles spacing better than the declaration (ttt) form.

### Font size

<code>\tiny</code>	<code>tiny</code>	<code>\Large Large</code>
<code>\scriptsize</code>	<code>scriptsize</code>	<code>\LARGE LARGE</code>
<code>\footnotesize</code>	<code>footnotesize</code>	
<code>\small</code>	<code>small</code>	<code>\huge huge</code>
<code>\normalsize</code>	<code>normalsize</code>	
<code>\large</code>	<code>large</code>	<code>\Huge Huge</code>

These are declarations and should be used in the form `{\small ...}`, or without braces to affect the entire document.

### Verbatim text

<code>\begin{verbatim}</code>	Verbatim environment.
<code>\begin{verbatim*}</code>	Spaces are shown as <code>\ </code> .
<code>\verb!text!</code>	Text between the delimiting characters (in this case '!') is verbatim.

## Justification

Environment	Declaration
<code>\begin{center}</code>	<code>\centering</code>
<code>\begin{flushleft}</code>	<code>\raggedright</code>
<code>\begin{flushright}</code>	<code>\raggedleft</code>

## Miscellaneous

`\linespread{x}` changes the line spacing by the multiplier *x*.

## Text-mode symbols

### Symbols

<code>\&amp;</code>	<code>\_</code>	<code>\ldots</code>	<code>\ldots</code>	<code>\textbullet</code>
<code>\\$</code>	<code>\`</code>	<code>\textbar</code>	<code>\textbackslash</code>	<code>\textbackslash\\$</code>
<code>\%</code>	<code>\~</code>	<code>\#</code>	<code>\#</code>	<code>\`i</code>

### Accents

<code>\`o</code>	<code>\^o</code>	<code>\~o</code>	<code>\~o</code>	<code>\=o</code>
<code>\`o</code>	<code>\\"o</code>	<code>\c{o}</code>	<code>\v{o}</code>	<code>\H{o}</code>
<code>\c{c}</code>	<code>\d{o}</code>	<code>\b{o}</code>	<code>\t{o}</code>	<code>\oe</code>
<code>\OE</code>	<code>\ae</code>	<code>\AE</code>	<code>\aa</code>	<code>\AA</code>
<code>\o</code>	<code>\O</code>	<code>\l</code>	<code>\L</code>	<code>\i</code>

### Delimiters

<code>\{</code>	<code>\}</code>	<code>\{</code>	<code>\}</code>	<code>\{ \}</code>
<code>\[</code>	<code>\]</code>	<code>\[</code>	<code>\]</code>	<code>\[ \]</code>

### Dashes

Name	Source	Example	Usage
hyphen	-	X-ray	In words.
en-dash	--	1–5	Between numbers.
em-dash	---	Yes—or no?	Punctuation.

## Line and page breaks

`\newline` Begin new line without new paragraph.

`\*\*` Prohibit pagebreak after linebreak.

`\kill` Don't print current line.

`\pagebreak` Start new page.

`\noindent` Do not indent current line.

## Miscellaneous

<code>\today</code>	March 28, 2017.
<code>\\$sim\$</code>	Prints ~ instead of <code>\~{}</code> , which makes ~.
<code>\~</code>	Space, disallow linebreak (W.J.\~Clinton).
<code>\.</code>	Indicate that the . ends a sentence when following an uppercase letter.
<code>\hspace{l}</code>	Horizontal space of length <i>l</i> (Ex: <i>l</i> = 20pt).
<code>\vspace{l}</code>	Vertical space of length <i>l</i> .
<code>\rule{w}{h}</code>	Line of width <i>w</i> and height <i>h</i> .

## Tabular environments

### tabbing environment

`\=` Set tab stop. `\>` Go to tab stop.

Tab stops can be set on “invisible” lines with `\kill` at the end of the line. Normally `\newline` is used to separate lines.

## tabular environment

```
\begin{array}[pos]{cols}
\begin{tabular}[pos]{cols}
\begin{tabular*}[width]{pos}{cols}
```

## tabular column specification

l	Left-justified column.
c	Centered column.
r	Right-justified column.
p[width]	Same as \parbox[t]{width}.
@{decl}	Insert decl instead of inter-column space.
	Inserts a vertical line between columns.

## tabular elements

\hline	Horizontal line between rows.
\cline{x-y}	Horizontal line across columns x through y.
\multicolumn{n}{cols}{text}	A cell that spans n columns, with cols column specification.

## Math mode

For inline math, use  $\dots$  or  $\dots$ . For displayed math, use  $\dots$  or  $\begin{equation}$ .

Superscript <sup>x</sup>	$\hat{x}$	Subscript <sub>x</sub>	$\_x$
$\frac{x}{y}$	$\frac{x}{y}$	$\sum_{k=1}^n$	$\sum_{k=1}^n$
$\sqrt{x}$	$\sqrt[n]{x}$	$\prod_{k=1}^n$	$\prod_{k=1}^n$

## Math-mode symbols

$\leq$	$\geq$	$\neq$	$\approx$	$\approx$
$\times$	$\times$	$\div$	$\pm$	$\cdot$
$\circ$	$\circ$	$\circ$	$\prime$	$\cdots$
$\infty$	$\infty$	$\neg$	$\wedge$	$\vee$
$\supset$	$\supset$	$\forall$	$\in$	$\rightarrow$
$\subset$	$\subset$	$\exists$	$\notin$	$\Rightarrow$
$\cup$	$\cap$	$\cap$	$\mid$	$\Leftrightarrow$
$\dot{a}$	$\hat{a}$	$\bar{a}$	$\tilde{a}$	
$\alpha$	$\beta$	$\gamma$	$\delta$	
$\epsilon$	$\zeta$	$\eta$	$\varepsilon$	
$\theta$	$\iota$	$\kappa$	$\vartheta$	
$\lambda$	$\mu$	$\nu$	$\xi$	
$\pi$	$\rho$	$\sigma$	$\tau$	
$\upsilon$	$\phi$	$\chi$	$\psi$	
$\omega$	$\Gamma$	$\Delta$	$\Theta$	
$\Lambda$	$\Xi$	$\Pi$	$\Sigma$	
$\Upsilon$	$\Phi$	$\Psi$	$\Omega$	

## Bibliography and citations

When using BibTeX, you need to run `latex`, `bibtex`, and `latex` twice more to resolve dependencies.

## Citation types

\cite{key}	Full author list and year. (Watson and Crick 1953)
\citeA{key}	Full author list. (Watson and Crick)
\citeN{key}	Full author list and year. Watson and Crick (1953)
\shortcite{key}	Abbreviated author list and year. ?
\shortciteA{key}	Abbreviated author list. ?
\shortciteN{key}	Abbreviated author list and year. ?
\citeyear{key}	Cite year only. (1953)
All the above have an NP variant without parentheses; Ex.	
\citeNP.	

## BIBTeX entry types

@article	Journal or magazine article.
@book	Book with publisher.
@booklet	Book without publisher.
@conference	Article in conference proceedings.
@inbook	A part of a book and/or range of pages.
@incollection	A part of book with its own title.
@misc	If nothing else fits.
@phdthesis	PhD. thesis.
@proceedings	Proceedings of a conference.
@techreport	Tech report, usually numbered in series.
@unpublished	Unpublished.

## BIBTeX fields

address	Address of publisher. Not necessary for major publishers.
author	Names of authors, of format ....
booktitle	Title of book when part of it is cited.
chapter	Chapter or section number.
edition	Edition of a book.
editor	Names of editors.
institution	Sponsoring institution of tech. report.
journal	Journal name.
key	Used for cross ref. when no author.
month	Month published. Use 3-letter abbreviation.
note	Any additional information.
number	Number of journal or magazine.
organization	Organization that sponsors a conference.
pages	Page range (2,6,9--12).
publisher	Publisher's name.
school	Name of school (for thesis).
series	Name of series of books.
title	Title of work.
type	Type of tech. report, ex. "Research Note".
volume	Volume of a journal or book.
year	Year of publication.

Not all fields need to be filled. See example below.

## Common BibTeX style files

abbrv	Standard	abstract	alpha with abstract
alpha	Standard	apa	APA
plain	Standard	unsrt	Unsorted

The L<sup>A</sup>T<sub>E</sub>X document should have the following two lines just before `\end{document}`, where `bibfile.bib` is the name of the BibTeX file.

```
\bibliographystyle{plain}
\bibliography{bibfile}
```

## BIBTeX example

The BibTeX database goes in a file called `file.bib`, which is processed with `bibtex` file.

```
@String{N = {Na-ture}}
@Article{WC:1953,
  author = {James Watson and Francis Crick},
  title = {A structure for Deoxyribose Nucleic Acid},
  journal = N,
  volume = {171},
  pages = {737},
  year = 1953
}
```

## Sample L<sup>A</sup>T<sub>E</sub>X document

```
\documentclass[11pt]{article}
\usepackage{fullpage}
\title{Template}
\author{Name}
\begin{document}
\maketitle

\section{section}
\subsection*{subsection without number}
text \textbf{bold text} text. Some math: $2+2=5$ 
\subsection{subsection}
text \emph{emphasized text} text. \cite{WC:1953} discovered the structure of DNA.
```

A table:

```
\begin{table} [!th]
\begin{tabular}{|l|c|r|}
\hline
first & row & data \\
second & row & data \\
\hline
\end{tabular}
\caption{This is the caption}
\label{ex:table}
\end{table}
```

The table is numbered `\ref{ex:table}`.  
`\end{document}`

# Lists

## Lists

In Python, lists are ordered collections of items that allow for easy use of a set of data.

List values are placed in between square brackets [ ], separated by commas. It is good practice to put a space between the comma and the next value. The values in a list do not need to be unique (the same value can be repeated).

Empty lists do not contain any values within the square brackets.

## Adding Lists Together

In Python, lists can be added to each other using the plus symbol + . As shown in the code block, this will result in a new list containing the same items in the same order with the first list's items coming first.

**Note:** This will not work for adding one item at a time (use .append() method). In order to add one item, create a new list with a single value and then use the plus symbol to add the list.

## Python Lists: Data Types

In Python, lists are a versatile data type that can contain multiple different data types within the same square brackets. The possible data types within a list include numbers, strings, other objects, and even other lists.

```
primes = [2, 3, 5, 7, 11]
```

```
print(primes)
```

```
empty_list = []
```

```
items = ['cake', 'cookie', 'bread']
```

```
total_items = items + ['biscuit', 'tart']
```

```
print(total_items)
```

```
# Result: ['cake', 'cookie', 'bread',
'biscuit', 'tart']
```

```
numbers = [1, 2, 3, 4, 10]
```

```
names = ['Jenny', 'Sam', 'Alexis']
```

```
mixed = ['Jenny', 1, 2]
```

```
list_of_lists = [['a', 1], ['b', 2]]
```

## List Method .append()

In Python, you can add values to the end of a list using the .append() method. This will place the object passed in as a new element at the very end of the list. Printing the list afterwards will visually show the appended value. This .append() method is *not* to be confused with returning an entirely new list with the passed object.

```
orders = ['daisies', 'periwinkle']
```

```
orders.append('tulips')
```

```
print(orders)
```

```
# Result: ['daisies', 'periwinkle',
'tulips']
```

## Zero-Indexing

In Python, list index begins at zero and ends at the length of the list minus one. For example, in this list, 'Andy' is found at index 2 .

```
names = ['Roger', 'Rafael', 'Andy',
'Novak']
```

## List Indices

Python list elements are ordered by *index*, a number referring to their placement in the list. List indices start at 0 and increment by one.

To access a list element by index, square bracket notation is used: `list[index]`.

```
berries = ["blueberry", "cranberry",
           "raspberry"]
```

```
berries[0]    # "blueberry"
berries[2]    # "raspberry"
```

## Negative List Indices

Negative indices for lists in Python can be used to reference elements in relation to the end of a list. This can be used to access single list elements or as part of defining a list range. For instance:

To select the last element, `my_list[-1]`.

To select the last three elements, `my_list[-3:]`.

To select everything except the last two elements,  
`my_list[:-2]`.

```
soups = ['minestrone', 'lentil', 'pho',
         'laksa']
soups[-1]    # 'laksa'
soups[-3:]   # 'lentil', 'pho', 'laksa'
soups[:-2]   # 'minestrone', 'lentil'
```

## Modifying 2D Lists

In order to modify elements in a 2D list, an index for the sublist and the index for the element of the sublist need to be provided. The format for this is `list[sublist_index][element_in_sublist_index] = new_value`.

```
# A 2D list of names and hobbies
class_name_hobbies = [["Jenny",
                       "Breakdancing"], ["Alexus",
                                         "Photography"], ["Grace", "Soccer"]]
```

```
# The sublist of Jenny is at index 0. The
# hobby is at index 1 of the sublist.
class_name_hobbies[0][1] = "Meditation"
print(class_name_hobbies)
```

```
# Output
# [[{"Jenny": "Meditation"}, {"Alexus": "Photography"}, {"Grace": "Soccer"}]]
```

## Accessing 2D Lists

In order to access elements in a 2D list, an index for the sublist and the index for the element of the sublist both need to be provided. The format for this is

```
list[sublist_index][element_in_sublist_index] .
```

```
# 2D list of people's heights
heights = [["Noelle", 61], ["Ali", 70],
            ["Sam", 67]]
# Access the sublist at index 0, and then
# access the 1st index of that sublist.
noelles_height = heights[0][1]
print(noelles_height)

# Output
# 61
```

## List Method .remove()

The `.remove()` method in Python is used to remove an element from a list by passing in the value of the element to be removed as an argument. In the case where two or more elements in the list have the same value, the first occurrence of the element is removed.

```
# Create a list
shopping_line = ["Cole", "Kip", "Chris",
                  "Sylvana", "Chris"]

# Removes the first occurrence of "Chris"
shopping_line.remove("Chris")
print(shopping_line)

# Output
# ["Cole", "Kip", "Sylvana", "Chris"]
```

## List Method .count()

The `.count()` Python list method searches a list for whatever search term it receives as an argument, then returns the number of matching entries found.

```
backpack = ['pencil', 'pen', 'notebook',
            'textbook', 'pen', 'highlighter', 'pen']
numPen = backpack.count('pen')

print(numPen)
# Output: 3
```

## Determining List Length with `len()`

The Python `len()` function can be used to determine the number of items found in the list it accepts as an argument.

```
knapsack = [2, 4, 3, 7, 10]
size = len(knapsack)
print(size)
# Output: 5
```

## List Method .sort()

The `.sort()` Python list method will sort the contents of whatever list it is called on. Numerical lists will be sorted in ascending order, and lists of Strings will be sorted into alphabetical order. It modifies the original list, and has no return value.

## List Slicing

A *slice*, or sub-list of Python list elements can be selected from a list using a colon-separated starting and ending point.

The syntax pattern is `myList[START_NUMBER:END_NUMBER]`.

The slice will include the `START_NUMBER` index, and everything until but excluding the `END_NUMBER` item.

When slicing a list, a new list is returned, so if the slice is saved and then altered, the original list remains the same.

```
exampleList = [4, 2, 1, 3]
exampleList.sort()
print(exampleList)
# Output: [1, 2, 3, 4]
```

```
tools = ['pen', 'hammer', 'lever']
tools_slice = tools[1:3] # ['hammer', 'lever']
tools_slice[0] = 'nail'

# Original list is unaltered:
print(tools) # ['pen', 'hammer', 'lever']
```

## sorted() Function

The Python `sorted()` function accepts a list as an argument, and will return a new, sorted list containing the same elements as the original. Numerical lists will be sorted in ascending order, and lists of Strings will be sorted into alphabetical order. It does not modify the original, unsorted list.

## List Method .insert()

The Python list method `.insert()` allows us to add an element to a specific index in a list.

It takes in two inputs:

The index that you want to insert into.

The element that you want to insert at the specified index.

```
unsortedList = [4, 2, 1, 3]
sortedList = sorted(unsortedList)
print(sortedList)
# Output: [1, 2, 3, 4]
```

```
# Here is a list representing a line of
people at a store
store_line = ["Karla", "Maxium", "Martim",
"Isabella"]

# Here is how to insert "Vikor" after
# "Maxium" and before "Martim"
store_line.insert(2, "Vikor")

print(store_line)
# Output: ['Karla', 'Maxium', 'Vikor',
'Martim', 'Isabella']
```

## List Method .pop()

The `.pop()` method allows us to remove an element from a list while also returning it. It accepts one optional input which is the index of the element to remove. If no index is provided, then the last element in the list will be removed and returned.

```
cs_topics = ["Python", "Data Structures",
"Balloon Making", "Algorithms", "Clowns
101"]
```

```
# Pop the last element
removed_element = cs_topics.pop()

print(cs_topics)
print(removed_element)
```

```
# Output:
# ['Python', 'Data Structures', 'Balloon
Making', 'Algorithms']
# 'Clowns 101'
```

```
# Pop the element "Balloon Making"
cs_topics.pop(2)
print(cs_topics)
```

```
# Output:
# ['Python', 'Data Structures',
'Algorithms']
```

# Data Wrangling

with pandas Cheat Sheet  
<http://pandas.pydata.org>

[Pandas API Reference](#) [Pandas User Guide](#)

## Creating DataFrames

	a	b	c
1	4	7	10
2	5	8	11
3	6	9	12

```
df = pd.DataFrame(
    {"a": [4, 5, 6],
     "b": [7, 8, 9],
     "c": [10, 11, 12]},
    index = [1, 2, 3])
```

Specify values for each column.

```
df = pd.DataFrame(
    [[4, 7, 10],
     [5, 8, 11],
     [6, 9, 12]],
    index=[1, 2, 3],
    columns=['a', 'b', 'c'])
```

Specify values for each row.

		a	b	c
N	v			
D	1	4	7	10
	2	5	8	11
e	2	6	9	12

```
df = pd.DataFrame(
    {"a": [4, 5, 6],
     "b": [7, 8, 9],
     "c": [10, 11, 12]},
    index = pd.MultiIndex.from_tuples(
        [('d', 1), ('d', 2),
         ('e', 2)], names=['n', 'v']))
```

Create DataFrame with a MultiIndex

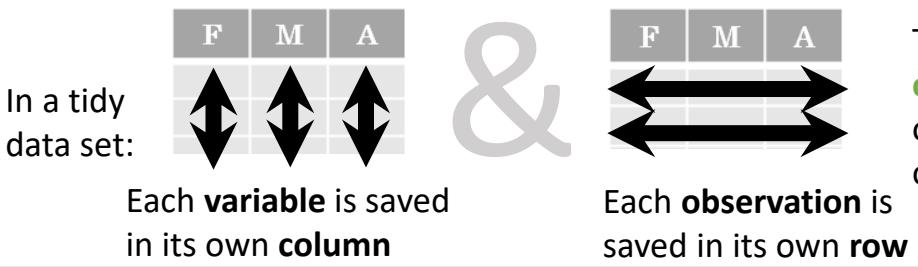
## Method Chaining

Most pandas methods return a DataFrame so that another pandas method can be applied to the result.

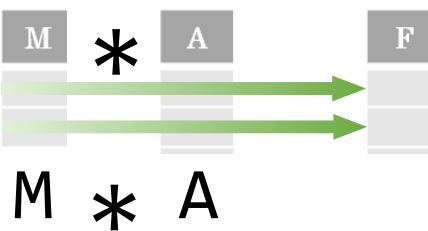
This improves readability of code.

```
df = (pd.melt(df)
      .rename(columns={
          'variable': 'var',
          'value': 'val'})
      .query('val >= 200'))
```

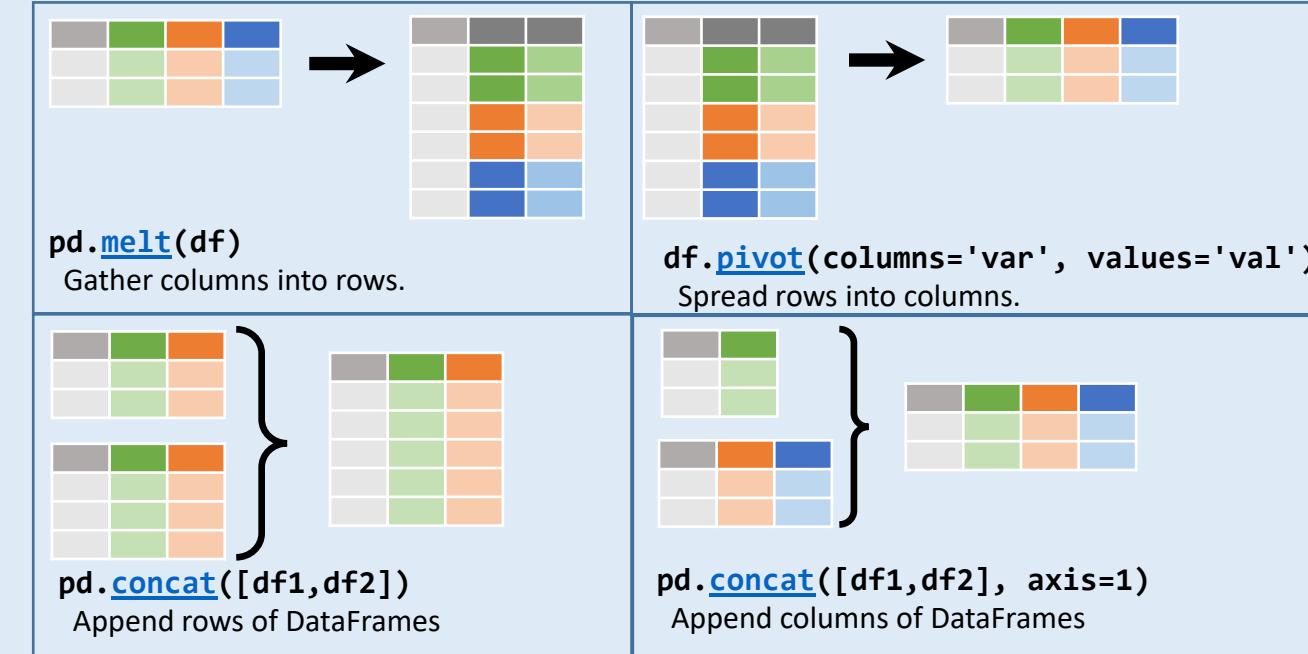
# Tidy Data – A foundation for wrangling in pandas



Tidy data complements pandas's **vectorized operations**. pandas will automatically preserve observations as you manipulate variables. No other format works as intuitively with pandas.



## Reshaping Data – Change layout, sorting, reindexing, renaming



- `df.sort_values('mpg')`  
Order rows by values of a column (low to high).
- `df.sort_values('mpg', ascending=False)`  
Order rows by values of a column (high to low).
- `df.rename(columns = {'y': 'year'})`  
Rename the columns of a DataFrame
- `df.sort_index()`  
Sort the index of a DataFrame
- `df.reset_index()`  
Reset index of DataFrame to row numbers, moving index to columns.
- `df.drop(columns=['Length', 'Height'])`  
Drop columns from DataFrame

## Subset Observations - rows



`df[df.Length > 7]`  
Extract rows that meet logical criteria.

`df.drop_duplicates()`  
Remove duplicate rows (only considers columns).

`df.sample(frac=0.5)`  
Randomly select fraction of rows.

`df.sample(n=10)` Randomly select n rows.

`df.nlargest(n, 'value')`  
Select and order top n entries.

`df.nsmallest(n, 'value')`  
Select and order bottom n entries.

`df.head(n)`  
Select first n rows.

`df.tail(n)`  
Select last n rows.

## Subset Variables - columns



`df[['width', 'length', 'species']]`  
Select multiple columns with specific names.

`df['width'] or df.width`  
Select single column with specific name.

`df.filter(regex='regex')`  
Select columns whose name matches regular expression regex.

## Using query

`query()` allows Boolean expressions for filtering rows.

`df.query('Length > 7')`  
`df.query('Length > 7 and Width < 8')`  
`df.query('Name.str.startswith("abc")', engine="python")`

Use `df.loc[]` and `df.iloc[]` to select only rows, only columns or both.

Use `df.at[]` and `df.iat[]` to access a single value by row and column.  
First index selects rows, second index columns.

`df.iloc[10:20]`  
Select rows 10-20.

`df.iloc[:, [1, 2, 5]]`  
Select columns in positions 1, 2 and 5 (first column is 0).

`df.loc[:, 'x2':'x4']`  
Select all columns between x2 and x4 (inclusive).

`df.loc[df['a'] > 10, ['a', 'c']]`  
Select rows meeting logical condition, and only the specific columns .

`df.iat[1, 2]` Access single value by index  
`df.at[4, 'A']` Access single value by label

## Logic in Python (and pandas)

<	Less than	!=	Not equal to
>	Greater than	df.column.isin(values)	Group membership
==	Equals	pd.isnull(obj)	Is NaN
<=	Less than or equals	pd.notnull(obj)	Is not NaN
>=	Greater than or equals	&,  , ~, ^, df.any(), df.all()	Logical and, or, not, xor, any, all

## regex (Regular Expressions) Examples

'.'	Matches strings containing a period '.'
'Length\$'	Matches strings ending with word 'Length'
'^Sepal'	Matches strings beginning with the word 'Sepal'
'^x[1-5]\$'	Matches strings beginning with 'x' and ending with 1,2,3,4,5
'^(?!Species\$).*''	Matches strings except the string 'Species'

# Summarize Data

`df['w'].value_counts()`

Count number of rows with each unique value of variable

`len(df)`

# of rows in DataFrame.

`df.shape`

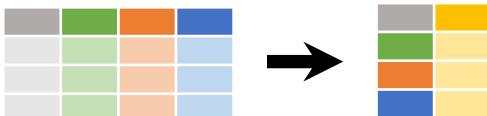
Tuple of # of rows, # of columns in DataFrame.

`df['w'].nunique()`

# of distinct values in a column.

`df.describe()`

Basic descriptive and statistics for each column (or GroupBy).



pandas provides a large set of [summary functions](#) that operate on different kinds of pandas objects (DataFrame columns, Series, GroupBy, Expanding and Rolling (see below)) and produce single values for each of the groups. When applied to a DataFrame, the result is returned as a pandas Series for each column. Examples:

`sum()`

Sum values of each object.

`count()`

Count non-NA/null values of each object.

`median()`

Median value of each object.

`quantile([0.25,0.75])`

Quantiles of each object.

`apply(function)`

Apply function to each object.

`min()`

Minimum value in each object.

`max()`

Maximum value in each object.

`mean()`

Mean value of each object.

`var()`

Variance of each object.

`std()`

Standard deviation of each object.

# Group Data

`df.groupby(by="col")`

Return a GroupBy object, grouped by values in column named "col".

`df.groupby(level="ind")`

Return a GroupBy object, grouped by values in index level named "ind".

All of the summary functions listed above can be applied to a group.

Additional GroupBy functions:

`size()`

Size of each group.

`agg(function)`

Aggregate group using function.

# Windows

`df.expanding()`

Return an Expanding object allowing summary functions to be applied cumulatively.

`df.rolling(n)`

Return a Rolling object allowing summary functions to be applied to windows of length n.

# Handling Missing Data

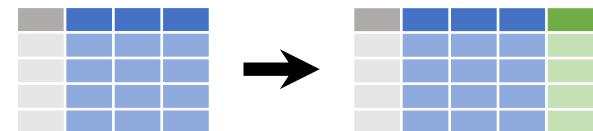
`df.dropna()`

Drop rows with any column having NA/null data.

`df.fillna(value)`

Replace all NA/null data with value.

# Make New Columns



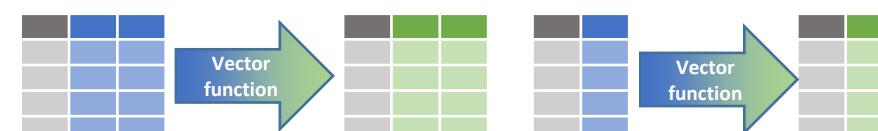
`df.assign(Area=lambda df: df.Length*df.Height)`

Compute and append one or more new columns.

`df['Volume'] = df.Length*df.Height*df.Depth`  
Add single column.

`pd.qcut(df.col, n, labels=False)`

Bin column into n buckets.



pandas provides a large set of **vector functions** that operate on all columns of a DataFrame or a single selected column (a pandas Series). These functions produce vectors of values for each of the columns, or a single Series for the individual Series. Examples:

`max(axis=1)`

Element-wise max.

`clip(lower=-10,upper=10)`

Trim values at input thresholds

`min(axis=1)`

Element-wise min.

`abs()`

Absolute value.

The examples below can also be applied to groups. In this case, the function is applied on a per-group basis, and the returned vectors are of the length of the original DataFrame.

`shift(1)`

Copy with values shifted by 1.

`rank(method='dense')`

Ranks with no gaps.

`rank(method='min')`

Ranks. Ties get min rank.

`rank(pct=True)`

Ranks rescaled to interval [0, 1].

`rank(method='first')`

Ranks. Ties go to first value.

`shift(-1)`

Copy with values lagged by 1.

`cumsum()`

Cumulative sum.

`cummax()`

Cumulative max.

`cummin()`

Cumulative min.

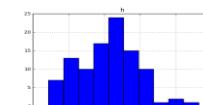
`cumprod()`

Cumulative product.

# Plotting

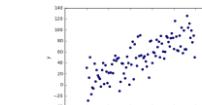
`df.plot.hist()`

Histogram for each column



`df.plot.scatter(x='w',y='h')`

Scatter chart using pairs of points



# Combine Data Sets

`adf`

x1	x2
A	1
B	2
C	3

`bdf`

x1	x3
A	T
B	F
D	T



Standard Joins

x1	x2	x3
A	1	T
B	2	F
C	3	NaN

`pd.merge(adf, bdf, how='left', on='x1')`  
Join matching rows from bdf to adf.

x1	x2	x3
A	1.0	T
B	2.0	F
D	NaN	T

`pd.merge(adf, bdf, how='right', on='x1')`  
Join matching rows from adf to bdf.

x1	x2	x3
A	1	T
B	2	F

`pd.merge(adf, bdf, how='inner', on='x1')`  
Join data. Retain only rows in both sets.

x1	x2	x3
A	1	T
B	2	F
C	3	NaN
D	NaN	T

`pd.merge(adf, bdf, how='outer', on='x1')`  
Join data. Retain all values, all rows.

Filtering Joins

x1	x2
A	1
B	2

x1	x2
C	3

`adf[adf.x1.isin(bdf.x1)]`  
All rows in adf that have a match in bdf.

`adf[~adf.x1.isin(bdf.x1)]`  
All rows in adf that do not have a match in bdf.

`ydf`

x1	x2
A	1
B	2
C	3

`zdf`

x1	x2
B	2
C	3
D	4



# Pip Cheatsheet

<b>General Parameters</b>		<b>Description</b>	
-v,--verbose		Verbose mode (More output)	-r FILE,--requirement FILE Uninstall packages listed in requirements file
-q,--quiet		Quiet mode (Less output)	-y,--yes Assume "yes" for questions
-h,--help		Help/Options	<b>Freeze</b> <b>Description</b>
-V,--version		Display version info	pip freeze Generate requirements file
--isolated		Ignore environment variables and user configuration	-r FILE,--requirement FILE Use the order given in the file
--log PATH		Log file	-f URL,--find-links URL URL for finding packages
--proxy PROXY		USER:PSWD@SERVER:PORT	-l,--local Only list virtualenv packages
--retries X		Retry connection X times	--user Only list user-site packages
--timeout SECONDS		Try for X seconds before retry	<b>Install</b> <b>Description</b>
--cache-dir DIR		Cache directory	pip install PKG Install package
--no-cache-dir		Disable cache	pip install PKG==1.0 Install specific version
--disable-pip-version-check		Do not check Pip version	pip install 'PKG>=1.0' At least, install version X
--cert PATH		Path to secondary CA bundle	-r FILE,--requirement FILE Install listed packages in the requirements file
--client-cert CERT		Path to SSL certificate	-b DIR,--build DIR Directory for building packages
--trusted-host HOSTNAME		Consider the host trusted	-t DIR,--target DIR Install in directory
<b>List</b>		<b>Description</b>	-d DIR, --download DIR Download only
pip list		List packages	-U,--upgrade Update listed packages
-o,--outdated		List outdated packages	--force-reinstall Re-install packages when updating
-u,--uptodate		List current packages	-l,--ignore-installed Re-install
-e,--editable		List editable items	--no-deps Do not install dependencies
-l,--local		List local virtualenv packages	--egg Install as an Egg
--user		List user-site packages	--compile Compile *.py to *.pyc
--pre		Include developmental packages	--no-compile Do not compile
-i URL,--index-url URL		PyPI URL	--no-use-wheel Do not use wheels
--extra-index-url URL		Additional package repos	--pre Include developmental versions
--no-index		Ignore package index	--no-clean Do not clean build directories
-f URL,--find-links URL		Search for archives at the URL	-i URL,--index-url URL PyPI URL
--allow-external PKG		Allow package installation	--extra-index-url URL Additional URLs
--allow-all-external		Allow externally hosted packages to be installed	--no-index Only use --find-links URLs
--allow-unverified PKG		Install insecure package	-f URL,--find-links URL Parse links for archives
--process-dependency-links		Process links for dependencies	--allow-external PKG Install 3 <sup>rd</sup> -party package
<b>Show</b>		<b>Description</b>	--allow-all-external Install 3 <sup>rd</sup> -party packages
pip show PKG		Display package info	--allow-unverified PKG Install unverified package
-f, --files		List package's files	--process-dependency-links Process links for dependencies
<b>Search</b>		<b>Description</b>	
pip search KEYWORD		Search PyPI for keyword	
--index URL		Repo to search	
<b>Uninstall</b>		<b>Description</b>	
pip uninstall PKG		Uninstall/remove package	

# Python For Data Science Seaborn Cheat Sheet

Learn Seaborn online at [www.DataCamp.com](http://www.DataCamp.com)

## Statistical Data Visualization With Seaborn

The Python visualization library **Seaborn** is based on `matplotlib` and provides a high-level interface for drawing attractive statistical graphics.

**Make use of the following aliases to import the libraries:**

```
>>> import matplotlib.pyplot as plt
>>> import seaborn as sns
```

The basic steps to creating plots with Seaborn are:

1. Prepare some data
2. Control figure aesthetics
3. Plot with Seaborn
4. Further customize your plot
5. Show your plot

```
>>> import matplotlib.pyplot as plt
>>> import seaborn as sns
>>> tips = sns.load_dataset("tips") #Step 1
>>> sns.set_style("whitegrid") #Step 2
>>> g = sns.lmplot(x="tip", #Step 3
                   y="total_bill",
                   data=tips,
                   aspect=2)
>>> g.set_axis_labels("Tip","Total bill(USD)").set(xlim=(0,10),ylim=(0,100))
>>> plt.title("title") #Step 4
>>> plt.show(g) #Step 5
```

## 1 Data

Also see [Lists, NumPy & Pandas](#)

```
>>> import pandas as pd
>>> import numpy as np
>>> uniform_data = np.random.rand(10, 12)
>>> data = pd.DataFrame({‘x’:np.arange(1,101),
                       ‘y’:np.random.normal(0,4,100)})
```

Seaborn also offers built-in data sets:

```
>>> titanic = sns.load_dataset("titanic")
>>> iris = sns.load_dataset("iris")
```

## 2 Figure Aesthetics

Also see [Matplotlib](#)

```
>>> f, ax = plt.subplots(figsize=(5,6)) #Create a figure and one subplot
```

### Seaborn styles

```
>>> sns.set() #Re)set the seaborn default
>>> sns.set_style("whitegrid") #Set the matplotlib parameters
>>> sns.set_style("ticks", #Set the matplotlib parameters
                  {“x tick.major.size”:8,
                   “y tick.major.size”:8})
#Return a dict of params or use with to temporarily set the style
>>> sns.axes_style("whitegrid")
```

## 3 Plotting With Seaborn

### Axis Grids

```
>>> g = sns.FacetGrid(titanic, #Subplot grid for plotting conditional relationships
                      col="survived",
                      row="sex")
>>> g.map(plt.hist, "age")
>>> sns.factorplot(x="pclass", #Draw a categorical plot onto a Facetgrid
                     y="survived",
                     hue="sex",
                     data=titanic)
>>> sns.lmplot(x="sepal_width", #Plot data and regression model fits across a FacetGrid
                  y="sepal_length",
                  hue="species",
                  data=iris)
>>> h = sns.PairGrid(iris) #Subplot grid for plotting pairwise relationships
>>> h = h.map(plt.scatter)
>>> sns.pairplot(iris) #Plot pairwise bivariate distributions
>>> i = sns.JointGrid(x="x", #Grid for bivariate plot with marginal univariate plots
                      y="y",
                      data=data)
>>> i = i.plot(sns.regplot,
                  sns.distplot)
>>> sns.jointplot("sepal_length", #Plot bivariate distribution
                  "sepal_width",
                  data=iris,
                  kind='kde')
```

## 4 Further Customizations

Also see [Matplotlib](#)

### Axisgrid Objects

```
>>> g.despine(left=True) #Remove left spine
>>> g.set_ylabels("Survived") #Set the labels of the y-axis
>>> g.set_xticklabels(rotation=45) #Set the tick labels for x
>>> g.set_axis_labels("Survived", #Set the axis labels
                      "Sex")
>>> h.set(xlim=(0,5), #Set the limit and ticks of the x-and y-axis
          ylim=(0,5),
          xticks=[0,2.5,5],
          yticks=[0,2.5,5])
```

### Plot

```
>>> plt.title("A Title") #Add plot title
>>> plt.ylabel("Survived") #Adjust the label of the y-axis
>>> plt.xlabel("Sex") #Adjust the label of the x-axis
>>> plt.ylim(0,100) #Adjust the limits of the y-axis
>>> plt.xlim(0,10) #Adjust the limits of the x-axis
>>> plt.setp(ax,yticks=[0,5]) #Adjust a plot property
>>> plt.tight_layout() #Adjust subplot params
```

### Context Functions

```
>>> sns.set_context("talk") #Set context to "talk"
>>> sns.set_context("notebook", #Set context to "notebook",
                     font_scale=1.5, #Scale font elements and
                     rc={“lines.linewidth”:2.5}) #override param mapping
```

### Color Palette

```
>>> sns.set_palette("husl",3) #Define the color palette
>>> sns.color_palette("husl") #Use with with to temporarily set palette
>>> flatui = [“#9b59b6”, “#3498db”, “#95a5a6”, “#e74c3c”, “#34495e”, “#2ecc71”]
>>> sns.set_palette(flatui) #Set your own color palette
```

### Regression Plots

```
>>> sns.regplot(x="sepal_width", #Plot data and a linear regression model fit
                  y="sepal_length",
                  data=iris,
                  ax=ax)
```

### Distribution Plots

```
>>> plot = sns.distplot(data.y, #Plot univariate distribution
                           kde=False,
                           color="b")
```

### Matrix Plots

```
>>> sns.heatmap(uniform_data,vmin=0,vmax=1) #Heatmap
```

### Categorical Plots

#### Scatterplot

```
>>> sns.stripplot(x="species", #Scatterplot with one categorical variable
                      y="petal_length",
                      data=iris)
>>> sns.swarmplot(x="species", #Categorical scatterplot with non-overlapping points
                      y="petal_length",
                      data=iris)
```

#### Bar Chart

```
>>> sns.barplot(x="sex", #Show point estimates & confidence intervals with scatterplot glyphs
                  y="survived",
                  hue="class",
                  data=titanic)
```

#### Count Plot

```
>>> sns.countplot(x="deck", #Show count of observations
                      data=titanic,
                      palette="Greens_d")
```

#### Point Plot

```
>>> sns.pointplot(x="class", #Show point estimates & confidence intervals as rectangular bars
                      y="survived",
                      hue="sex",
                      data=titanic,
                      palette={"male":“g”,
                               “female”:“m”},
                      markers=[“^”, “o”],
                      linestyles=[“-”, “--”])
```

#### Boxplot

```
>>> sns.boxplot(x="alive", #Boxplot
                  y="age",
                  hue="adult_male",
                  data=titanic)
>>> sns.boxplot(data=iris,orient="h") #Boxplot with wide-form data
```

#### Violinplot

```
>>> sns.violinplot(x="age", #Violin plot
                      y="sex",
                      hue="survived",
                      data=titanic)
```

## 5 Show or Save Plot

Also see [Matplotlib](#)

```
>>> plt.show() #Show the plot
>>> plt.savefig("foo.png") #Save the plot as a figure
>>> plt.savefig("foo.png", #Save transparent figure
                  transparent=True)
```

## > Close & Clear

Also see [Matplotlib](#)

```
>>> plt.cla() #Clear an axis
>>> plt.clf() #Clear an entire figure
>>> plt.close() #Close a window
```

# Strings

## Strings

In computer science, sequences of characters are referred to as *strings*. Strings can be any length and can include any character such as letters, numbers, symbols, and whitespace (spaces, tabs, new lines).

## Escaping Characters

Backslashes (\ ) are used to escape characters in a Python string.

For instance, to print a string with quotation marks, the given code snippet can be used.

```
txt = "She said \"Never let go\"."
print(txt) # She said "Never let go".
```

## The in Syntax

The `in` syntax is used to determine if a letter or a substring exists in a string. It returns `True` if a match is found, otherwise `False` is returned.

```
game = "Popular Nintendo Game: Mario Kart"
print("l" in game) # Prints: True
print("x" in game) # Prints: False
```

## Indexing and Slicing Strings

Python strings can be indexed using the same notation as lists, since strings are lists of characters. A single character can be accessed with bracket notation (`[index]`), or a substring can be accessed using slicing (`[start:end]`).

Indexing with negative numbers counts from the end of the string.

```
str = 'yellow'
str[1]      # => 'e'
str[-1]     # => 'w'
str[4:6]    # => 'ow'
str[:4]     # => ' yell'
str[-3:]   # => 'low'
```

## Iterate String

To iterate through a string in Python, “for...in” notation is used.

```
str = "hello"
for c in str:
    print(c)

# h
# e
# l
# l
# o
```

## Built-in Function len()

In Python, the built-in `len()` function can be used to determine the length of an object. It can be used to compute the length of strings, lists, sets, and other countable objects.

```
length = len("Hello")
print(length)
# Output: 5

colors = ['red', 'yellow', 'green']
print(len(colors))
# Output: 3
```

## String Concatenation

To combine the content of two strings into a single string, Python provides the `+` operator. This process of joining strings is called concatenation.

```
x = 'One fish, '
y = 'two fish.'

z = x + y

print(z)
# Output: One fish, two fish.
```

## Immutable strings

Strings are immutable in Python. This means that once a string has been defined, it can't be changed. There are no mutating methods for strings. This is unlike data types like lists, which can be modified once they are created.

## IndexError

When indexing into a string in Python, if you try to access an index that doesn't exist, an `IndexError` is generated. For example, the following code would create an `IndexError`:

## Python String .format()

The Python string method `.format()` replaces empty brace `{}` placeholders in the string with its arguments. If keywords are specified within the placeholders, they are replaced with the corresponding named arguments to the method.

```
fruit = "Berry"
idx = fruit[6]
```

```
msg1 = 'Fred scored {} out of {} points.'
msg1.format(3, 10)
# => 'Fred scored 3 out of 10 points.'
```

```
msg2 = 'Fred {verb} a {adjective} {noun}.'
msg2.format(adjective='fluffy',
verb='tickled', noun='hamster')
# => 'Fred tickled a fluffy hamster.'
```

## String Method .lower()

The string method `.lower()` returns a string with all uppercase characters converted into lowercase.

```
greeting = "Welcome To Chili's"
```

```
print(greeting.lower())
# Prints: welcome to chili's
```

## String Method .strip()

The string method `.strip()` can be used to remove characters from the beginning and end of a string. A string argument can be passed to the method, specifying the set of characters to be stripped. With no arguments to the method, whitespace is removed.

```
text1 = '    apples and oranges    '
text1.strip()          # => 'apples and
                       oranges'

text2 = '...+...lemons and limes...-...'

# Here we strip just the " ." characters
text2.strip('. ')     # => '+...lemons and
                       limes...-'

# Here we strip both " ." and " +"
# characters
text2.strip('.+')    # => 'lemons and
                       limes...-'

# Here we strip " .", " +", and " -"
# characters
text2.strip('.+-')   # => 'lemons and
                       limes'
```

## String Method .title()

The string method `.title()` returns the string in title case. With title case, the first character of each word is capitalized while the rest of the characters are lowercase.

```
my_var = "dark knight"
print(my_var.title())
```

# Prints: Dark Knight

## String Method .split()

The string method `.split()` splits a string into a list of items:

If no argument is passed, the default behavior is to split on whitespace.

If an argument is passed to the method, that value is used as the delimiter on which to split the string.

```
text = "Silicon Valley"

print(text.split())
# Prints: ['Silicon', 'Valley']

print(text.split('i'))
# Prints: ['S', 'l', 'con Valley']
```

## Python string method .find()

The Python string method `.find()` returns the index of the first occurrence of the string passed as the argument. It returns `-1` if no occurrence is found.

```
mountain_name = "Mount Kilimanjaro"
print(mountain_name.find("o")) # Prints
1 in the console.
```

## String replace

The `.replace()` method is used to replace the occurrence of the first argument with the second argument within the string.

The first argument is the old substring to be replaced, and the second argument is the new substring that will replace every occurrence of the first one within the string.

## String Method .upper()

The string method `.upper()` returns the string with all lowercase characters converted to uppercase.

```
fruit = "Strawberry"
print(fruit.replace('r', 'R'))
# StRawbeRRy
```

```
dinosaur = "T-Rex"
```

```
print(dinosaur.upper())
# Prints: T-REX
```

## String Method .join()

The string method `.join()` concatenates a list of strings together to create a new string joined with the desired delimiter.

The `.join()` method is run on the delimiter and the array of strings to be concatenated together is passed in as an argument.

```
x = "-".join(["Codecademy", "is",
"awesome"])
print(x)
# Prints: Codecademy-is-awesome
```