BIG DADDY'S PYTHON For 3.6+ TOOLBOX

vPro2022b

www.wikipython.com 013022 *in this document the symbol ↳ means yields, results in, or produces

print() function: default = '\n'
print(*objects*, separator="", end='\n')
print("Hello World!") ↳ **Hello World!**

Operators

Math: **=**(execute/assign) **+**; **-**; *****; **/**; ****** (exp); **+=** a+=b ↳ a=a+b; **-=**; ***=**; ****=**; **/=**; **//=** floor div (int with no remainder); **%** (**mod**ulo) ↳ remainder from division; *value swap* a,b=b,a;
Boolean: **False, True** (0 , 1)
Logical: **and, or, not** *modify compare*
Comparison: **==** **(same as)**; **!=** (is **not** equal); **<**; **<=**; **>**; **>=**; **is**; **is not**; all ↳ **Boolean** values **— (T/F)**
Membership: **in**; **not in**; - a list, tuple, string, dictionary, or set
Identity: **is**; **is not** the same object
Binary: **&** (and); **|** (or); **^** (xor - 1 not both); **~** inversion, = -(x+1); **<<** (shift left); **>>**(shift right)
bin(0b0101 <<1) ↳ '0b1010'
Sequence Variable Operators
strings: **+** **-**concatenate, ***** **-** repeat; **single char** slice s**[i]**; **range slice** s **[i:j:k]** **from**, **to**, **step** -> *start at i, end j-1, increment by count*

Coding Operators

\\ **Multiline (explicit join) Statements:** Not needed within [], {}, or ()
; **Multiple Statements on a Line:** not used/needed with **for, if, while**
# **line** comment
""" **block** comment """

Number Tools

abs(x) ↳ absolute value of x
bin(x)↳ int to binary bin(5)= '0b101' (a 4, no 2's, a 1); bin(7)[2:] = '111'
divmod(dividend,divisor) from noncomplex numbers ↳ quotient and remainder tuple
float(x) ↳ a floating point number from an integer or string; if x="1.1" print(float(x)*2) ↳ 2.2
hex(x) ↳ int to hex string hex(65536) ↳ 0x10000 or hex(65536)[2:] ↳ '10000'
oct(x) ↳ integer to octal
int(x) ↳ integer from float/string/hex
pow(x,y [,z]) ↳ x to y, if z is present, returns x to y, modulo z
pow(5,2)=25, pow(5,2,7)=4
round(number [,digits]) floating point number rounded to digits or nearest integer if digits not used
round(3.14159, 4) ↳ **3.1416**
max, **min**, **sort** - see data containers
None -> **constant** for null; x=None

String Tools

repr(object) ↳ printable string
ascii(str) ↳ like repr, esc non-ascii
eval("Python expression str") ↳ value
chr(i) ↳ character of Unicode 97= 'a'
input(prompt) ↳ user input as str
len() ↳ length of str; count of iterable items (list/dictionary/tuple/set)
ord(str)↳ value of Unicode char.
str(object) ↳ string val of object

slice selection: **str[***start*:*stop*[:*step*]**]; str [:***stop***];** ↳ a string created by the selection

String Formatting

.format() - ***see 2022 Format Toolbox!***
method: (1) substitution (2) pure format
(1) '***string* {*sub0*}{*sub1*}'.format(0, 1)**
print("Give {0} a {1}".format('me','kiss'))
(2) **'{:*format_spec*}'.format(*value*)**
function: format (***value, spec***)
format_spec: (format mini-language string)
[[**fill**] **align**] [**sign**] [# - alt form] [0-**forced pad**] [**width**] [**,**] [**.precision**] [**type**]
x, fmt = 12345.678, " **10,.2f**"
print(Pay $" + format(x, fmt)) **or**
New in 3.6 **f-strings**
print(f"Pay ${x:{fmt}}")
↳↳ Pay $ 12,345.68

see pg 4

format strings

.center(width[, fillchar]) string centered in width area using fill character 'fillchar'
.capitalize() ↳ **F**irst character capitalized
.ljust(width [, fillchar]) or **.rjust(***same args***)**
.lower()/.upper() ↳ change case
.strip; *or* **.lstrip**; *or* **.rstrip**; + **([chars])** ↳ a string with all *or* leading, *or* trailing, [chars] removed. If [chars] included, all are removed. If [chars] omitted or None, the argument removes whitespace
.swapcase() ↳ cases exchanged
.title() ↳ **F**irst **W**ords **C**apitalized
.zfill(width) - left fill with '0' to len width

String Methods

Str "**.is**" tests—(**Note**: tested here for characters 0 to 255) ↳ ***True*** if all chars in the string meet attribute condition and string =>1 character in length. ↳ False if Null
.isalnum()—True if all chars in a string are either .isalpha(), .isnumeric(), .isdigit() or .isdecimal() *Note False if your number contains a decimal point: to vet a variable v1 as a float: if (type (v1) == float): or convert in a **try/except** structure
.isalpha()—upper and lower case normal letters plus 64 printable characters between chr(170) and chr (255)
.isdecimal()—digits 0,1,2,3,4,5,6,7,8,9
.isdigit()—0 to 9 plus superscripts ² (178), ³ (179), and ¹(185)
.isidentifier()—tests a string to see if it is a valid Python identifier or keyword
.islower()—lower case ltrs plus 36 printable characters between chr(170) and chr(255)
.isnumeric()—.isdigit plus **¼** (188), **½** (189), and **¾** (190)
.isprintable()—189 of the 256 characters between 0 and 255 starting with the space chr(32) sequentially to ~ chr(126), then chr (161) to (255) except for chr(173)
.isspace()—true for chrs (9-13), (28-32), (133) and (160). Note space: **" "** is chr(32)
.istitle()—for all practical purposes, every word in a string begins with a capital letter
.isupper()—normal upper case plus 30 printable characters between chr(192-222)
.casefold() ↳ casefold - caseless matching
.count(sub[,start[,end]]) ↳ # of substrings
.encode(*encoding="utf-8", errors="strict"*)
.endswith *(suffix[, start[, end]])* ↳ ***T/F***
.expandtabs() replace tabs with spaces
.find(sub[, start[, end]**])** ↳ the index of **substring** start, or -1 if it is not found; print('Python'.find("th")) ↳ 2
.index(sub[,start[,end]]) = .find but failure to find sub causes *ValueError*
***separator*.join([string list])** joins strings in iterable with **sep** char; can be null
.partition(sep) ↳ 3 tuple: **before, sep, after**
[new 3.9] .removeprefix(prefix,/) and **.removesuffix**(suffix,/)
.replace(old, new[, count]) ↳ substring old replaced by new in object; if count is given, only the count number of values are replaced
.rfind(sub[, start[, end]]) ↳ lowest index of substring in slice [start:end]. -1 on fail
.rindex()rfind but fail ↳ *ValueError*
.rsplit— like **split,** except splits from right
.split([sep] [maxsplit=]) ↳ word list, default sep is space(s)
.splitlines(keepends=False) ↳ list of lines broken at line boundaries
.startswith(prefix[,start[,end]]**))** ↳ True/False prefix can be a tuple
.translate(table) map to table made with **.maketrans**(x,[,y[,z]])
(maketrans takes/makes strings)

Admin Built-in Functions

pass (placeholder – no action)
del deletes variables, data containers, items in iterables: del mylist[x]
breakpoint enters debugger - **with** wrapper ensures **_exit_** method
bool(expression) ↳**T/F**(F default)
callable(object) ↳**T**rue if it is
help(object) invokes built-in help system, (for interactive use)
id*(object)* ↳ unique identifier
:= (**New [3.8]**) - assignment expression operator assigns values to variables inside a larger expression
bytearray([source[, **encoding**[, **errors**]]**])** ↳ a new bytearray; source can be an iterable of integers 0 to 255, an integer defining array size, or a string witn encoding which will be converted to bytes using **str.encode()**
globals() ↳ a dictionary of current global symbols of the current module
isinstance(object, classinfo**)** ↳ True if object is an instance of classinfo
issubclass(object, classinfo**)** ↳ True if object is a subclass of classinfo
locals() ↳ a dictionary of the current local symbol table
vars([object]) ↳ the **__dict__** attribute for a module, class, instance or object

Looping

while (*True expression*)**:**
process data statements;
[else:] *if expression is false, do once*
for *expression to be iterated*: *usually with* **in** *or* **range (start, stop [,step])**
[else:] *executed unless a break statement interrupts execution cycle*
In **both for** or **while** loops:
break ends the innermost loop and prevents **else:** from executing,
continue skips to next loop cycle.
***if** *also supports an else statement and can be confusing if not placed as a peer*

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PYTHON TOOLBOX

For 3.6+

Decision Making

if elif else:

if some True statement**:** #execute code

elif alt True statement**:** # do this code

else: **#** otherwise execute this code

Ternary if: an inline **if** that can be use in formulas

print(x **if** x **in** myword **else** "", end="")

Functions * boldface not in this basic toolbox

abs()
all()
any()
ascii()
bin()
bool()
breakpoint()
bytearray()
bytes()
callable()
chr()
classmethod
compile()
complex()
delattr()
dict()
dir()
divmod()
enumerate()
eval()
exec()
filter()
float()
format()
frozenset()
getattr()
globals()
hasattr()
hash()
help()
hex()
id()
input()
int()
isinstance()
issubclass()
iter()
len()
list()
locals()
map()
max()
memoryview
min()
next()
object()
oct()
open()
ord()
pow()
print()
property()
range()
repr()
reversed()
round()
set()
setattr()
slice()
sorted()
staticmethod
str()
sum()
super()
tuple()
type()
vars()
zip()
__import__()

Error Management

use in error handling blocks

try: #code with error potential

except [*error type*]**:** #code if any error or a specified error occurs

else: #otherwise do this code

finally: #do this either way

assert: condition = **False** will raise an *AssertionError*

raise forces a specified, usually custom, exception. Custom errors are created as their own class. **ex:**

```
class TempTooHigh(Error):
   '''Arduino input over max range'''
   pass
```

Errors

ArithmeticError*
AssertionError
AttributeError
BaseException
BlockingIOError
BrokenPipeError
BufferError*
BytesWarning
ChildProcessError
ConnectionAbortedError
ConnectionError
ConnectionRefusedError
ConnectionResetError
DeprecationWarning
EOFError
EnvironmentError
FileExistsError
FileNotFoundError
FloatingPointError
IOError
ImportError
IndentationError
IndexError
InterruptedError
IsADirectoryError
KeyError
KeyboardInterrupt
LookupError*
MemoryError
ModuleNotFoundError
NameError
NotADirectoryError
NotImplementedError
OSError
OverflowError
PermissionError
ProcessLookupError
RecursionError
ReferenceError
RuntimeError
SyntaxError
SystemError
TabError
TimeoutError
TypeError
UnboundLocalError
UnicodeDecodeError
UnicodeEncodeError
UnicodeError
UnicodeTranslateError
ValueError
WindowsError
ZeroDivisionError

**non-system-exiting exceptions*

File Access and Methods

filepath=r"C:\files\mytest.txt"

Python natively handles only strings in files

open(filepath [,mode], buffering])

Typical useage: open in with structure:

```
with open("wholefilepath") [as xfile]:
    xfile=mytest.read().splitlines()
```

****with** structure automatically closes a file

Helpful *methods:* **.read(), .read(**size**), .readline(), .readlines(), .write(**string**), .close(), .splitlines([keepends]), list(openfile). .close()** – not needed in with structure

Many other functions **not shown here*

File Modes: ***open for***

'r' reading (default)
'w' writing, truncating the file first
'x' exclusive creation, fails if it exists
'a' writing, appending to the end of the file **if** it exists
'b' binary mode
't' text mode (default)
'+' for updating (reading and writing), ie. "r+" or "w+"

Object Methods

Working with object attributes (most useful for created class objects)

getattr(object, ‘name’ [, default])

```
listatr = getattr(list, '__dict__')
for item in listatr:
   print(item, listatr[item], sep="   |   ")
```

setattr(object, ‘name’, value)

hasattr(object, 'name')

delattr(object, 'name')

exec(string or code obj[, globals [, locals]]) dynamic code execution

compile(source, filename, mode, flags=0, don’t_inherit=False, optimize=-1) create a code object that **exec**() or **eval**() can execute

hash(object) ↳ integer hash value if available

dir() ↳ names in current local scope

dir(object) ↳valid object attributes

Helpful definitions: Iterable: an object that can return members 1 at a time **Mutable:** can be changed **Immutable:** can't **Ordered**: held in a fixed sequence **Unique**: can not contain any duplicate values

Set concepts and terms: diagram next page

Universal Iterable Tools

all(iterable)↳ True if all elements are True

any(iterable) ↳ True if any element is True *all and any are both FALSE if empty

del(iterable instance) - delete

enumerate(iterable, start = 0**)**↳ tuples list

```
alist = ['x','y','z'];  l1 = list(enumerate(alist));  print(l1)
↳ [(0,'x'), (1,'y'), (2,'z')]
```

filter(function, iterable) selector for elements for which function is True

iter and **next(iterator ,default])** create iterator with **iter**; fetch items with **next** ; default returned if iterator exhausted, or StopIteration ↲

```
team = ['Amy', 'Bo', 'Cy'];  it1 = iter(team);
myguy = ""
while myguy is not "Cy":
    myguy = next(it1, "end")
    print(myguy)
```

↳

```
Amy
Bo
Cy
```

map(function, iterable) can take multiple iterables - function must take just as many

```
alist=[5,9,13,24];  x = lambda z: (z+2)
list2 = list(map(x, alist));  print(list2)  ↳ [7,11,15,26]
```

range ([start,] stop [,step])

```
alist=["Amy","Bo","Cy"]
for i in range (0, len(alist)):
  print(str(i), alist[i])   # note slice
```

↳

```
0 Amy
1 Bo
2 Cy
```

reversed() reverse **iterator**: **list** or **tuple**

```
alist=["A","B","C"]; print(alist)
alist.reverse(); print(alist);
rev_iter = reversed(alist)
for letter in range(0, len(alist)):
   print(next(rev_iter), end=", ")
```

↳

```
['A', 'B', 'C']
['C', 'B', 'A']
A, B, C,
```

sum(iterable [, start]) all numeric

ex: if a=[8,7,9] then sum(a) ↳ 24

type([iterable]) ↳ object datatype

zip() creates aggregating iterator from multiple **iterables**, ↳ iterator of tuples of ith iterable elements from each sequence or iterable.

Iterable Data Container

Methods & Operations

↓ i,j,k: indexes | x: values/ objects

L / T / D / S / F / SF ↳ **instances** of: **list, tuple, dictionary, set, frozen set, both**

Unique Data Type Statements/Methods

LISTS: [ ] - Ordered, Mutable

create **L=[]; L=[[x[,x]…]]; L=list(L/T/S/F); list(D)** ↳ list of all dictionary **keys;** (list(D.values()) for list of values)

L=L2[i:j:k] *new list from slice of L2*

add/remove items **L1+L2** *concatenate (lists only)***; .append(**x**)** where x is string or data object**; .clear()** *remove all members***; .copy()** *duplicate list***; .extend(**iterable**)** *adds iter members; strings add letters as members***; insert** (item, position); **.pop(i)** *return and remove ith item, last item if no i;* **.remove(**x**)** *remove first item = x*

query **L[**x**]** ↳ *value at position x, can be multiple values: a,b=L[2:4]***; .count(x)** *find number of instances of x in list***; .index(x[,***at/after index* **i][,***before index* **j])** ↳ *slice position of string or value x in list, ValueError if not in found***; len(L); max(L); min(L);** x **in L;** x **not in L**

manipulate **.sort(**key=none/function, reverse=False**); sorted(L[**,reverse**]); L.reverse()** *reverse item order***;**

TUPLES: ( ) - Ordered, Immutable

create **T=(); T=(**x,**[[**x**],(**x**)…]);**

List Comprehensions

Make a new list with exclusions and modifications from an existing list or tuple: brackets around the expression, followed by 0 to *many* **for** or **if** clauses; clauses can be nested:

new_list = [(*modified*)item for item in old_list if some-item-attribute of (item)]

```
atuple=(1,-2,3,-4,5)
mylist=[item*2 for item in atuple if item>0]
print(atuple, mylist)
↳ (1, -2, 3, -4, 5)  [2, 6, 10]
```

if modifying items only: up1list =[x+1 for x in L]

TUPLES: (*continued from pg 2*)
T= tuple(T/L/S/F)
add* *members **+=(x,[x])** *add 1 or more items, note comma for 1 item*; **T1 + T2** *concatenate (tuples only)*
query **=T[i:j]** *get slice values, j is last item + 1;* **.count(x)** *find number of instances of x in tuple*; **T.index(x[,***at/ after index* **i][,***before index* **j])** ↳ *slice position of possible member x,*; **min(T); max(T); len(T);** x **in T;** x **not in T**
manipulate **sorted (T,** *reverse=T/F***);**
T[::-1] *reverse order*

DICTIONARIES: { } Mutable, Unordered, Unique keys **k** ↳ **'key', v** ↳ **'value'**
create **D={k:v, [,k:v]}; =dict(**i=j **[,**k=l**]); =dict(**zip(L1, L2)**); D2= D1.copy(); =dict.fromkeys (L/T/F ,** *pair members with v/None/ iterable***);**
add/remove members
D[k**]=***new_value*; **D.update(D**2) *add D2 items to D replacing dup values*; **D=(**D| **D2); D.setdefault(**k**[**,default**])** *return value if k in dict, if not, insert and return default*; **D.clear(); del D[**k**]** *remove member*; **D.pop(**k**)** ↳ v and removes k; new **[3.9]: D=D2|D3; D|=**k/v pairs;
query *x*=**D[k]** ↳ v or keyerror if no k; x=**D.get(**k[,x]**)** *like D[k] but* ↳ x if no k; **len**(**D**); Dictionary **views**: **D.keys(), D.values(), D.items()** *for* ***items view****, x* ↳ *a* ***list*** *of key:value* ***tuples****; all* ***views*** *can all be* ***iterated***
x in D.*view*; **x not in** D.*view*;
manipulate **D[**existing k**]=value** *change value*; ***[new in 3.8]*** *where ri is a reversed iterator* ***ri=reversed(D.****view****)*** *iterate with next(ri);* **sorted(D.items())**

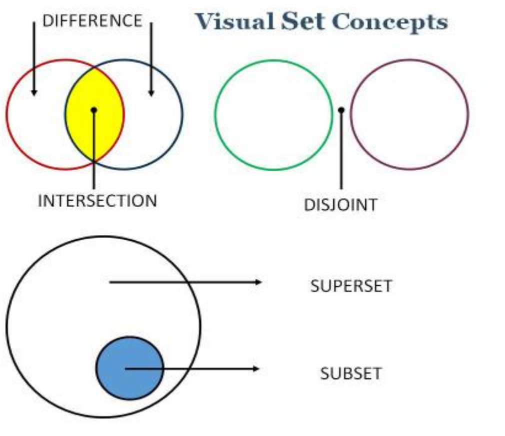
Use enumerate to make a dictionary. ex: mydict = dict(enumerate(mylist))

SETS: *Unique, Mutable*, Unordered
create **S=**{x,x,x}; **S=set(**L/T/F**);**
S='string' ↳ unique letters
FROZENSETS: *immutable after creation;*
create **F=frozenset**([iterable]) ☛ *only*

Set & Frozenset
Methods and Operations

SF.copy() *Return a shallow copy.*
SF.symmetric_difference(SF2) or **SF^SF2** e*lements in either, not both*
SF.union(SF2) *or* **SF3=SF**1 **|** SF2[|…] merge the sets
SF.intersection (SF2) *or* **SF1 & SF2** intersection of S1 & S2
SF.difference(S2) *or* **SF-SF**2 *unique in* **SF**
query (**Sets & Frozensets**) **len(SF);**
Boolean Tests: **x in SF; x not in SF;**
SF.isdisjoint(SF2) T if no common items
SF.issubset(SF2) & **SF1<=SF2** One set is contained by the other.
SF1<SF2 set is a proper subset
SF1.issuperset(**SF2**) *or* **SF1=>SF**2 Every element of SF1 in SF2
SF1>SF2 set is a proper superset
Sets ONLY ***add/remove members***
S.remove(element) *Key Error if missing*;
S.discard(element) *no error if missing*;
S.pop() *remove/return random element*; **S.clear(); S.add**(i)**; in; not in;**
S.update(iterable); *or* **S1** |= **S2;** *These add members from iterable(s) or set(s).*

S.intersection_update(other iterables**)**; *or* **S1 &= S2;** *Keep universal elements.*
S.difference_update(iterable) or **S1 -= S2** *Remove members found in others.*
S.symmetric_difference_update(iterable)
S1 ^= S2; keep unique elements only



*/** for iterable (argument) unpack

* for **list** & **tuples**: Ex: a,***b**,c = [1,2,3,4,5]
↳ a=1, c=5, **b**=[2,3,4]
** for **dictionaries**
d1={1:'a', 2:'b'}; d2={2:'c', 3:'d'} ;
d1={d1, **d2}** or new in [**3.9**] **d1|=d2**
↳ **d1={1:'a',2:'c',3:'d'}**

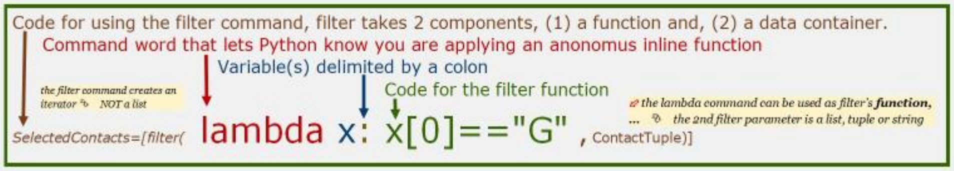
User Functions

def - command to create a user function
def function_name (args or kwargs): →
return(variable object) return the value(s) that a function derived ***- or -*** **yield/next** in a generator function, **yeild** returns a sequential value incremented by **next** after the function call (see below)
global x creates global variable - defined inside a function
nonlocal makes a variable in a nested function valid in an outer function

Creating a Function
(required in red, optional in green)
☜ ***command key word*** ☜ ***arguments***
1 **def** ***name*** (input or defined params)**:**
☜ *new* ***function name*** *colon* ☞
[***2*** """a docstring""" (can be multiline)]
next segment **code block**
last segment **return(**value to pass back**)**
or a ***generator*** passed using **yield**:

Example
```
vowels, myword = 'aeiouy','idea'
def gen1(wordin):
    for letter in wordin:
        yield(letter)
for letter in gen1(vowels):
    print(letter if letter in myword else "")
    next
```
↳ **aei**

Lambda: an unnamed **inline function**
lambda [parameter(s)]**:** expression
z = lambda x: format(x**3,",.2f");
print(**z**(52.1)) ↳ **141,420.76**


Code for using the filter command, filter takes 2 components, (1) a function and, (2) a data container.
Command word that lets Python know you are applying an anonomus inline function
Variable(s) delimited by a colon
Code for the filter function
the filter command creates an iterator ↳ *NOT a list*
the lambda command can be used as filter's ***function****, ...* ↳ *the 2nd filter parameter is a list, tuple or string*
```
SelectedContacts=[filter( lambda x: x[0]=="G" , ContactTuple)]
```

CLASS - an object blueprint

(***required*** *in red,* ***optional*** *in green)*
Common components of a class include:
1 **inheritance creates a "derived class"*
☜ *command key word* colon ☞
class class-name (inheritance)**:**
your class name ☜ *class* ***definition header***
Class creates a namespace and provides ***instantiation*** *and* ***attribute references***
2 a **docstring**, '"Docstring example"'
3 instantiation with **special method:**
def __init__(self, arguments):
~ autoinvoked when class is created;
~ arguments are passed when a class instantiation is called.
~ Includes variable name assignments, etc.
4 **function definitions and local variable assignments**

Example
```
❶ class mammalia(object):
❷     "A class for mammal classification"
❸     def __init__(self, order, example):
          self.ord = order
          self.ex = example
          self.cls="mammal"
❹     def printInfo(self):
          info="class/order: " + self.cls + "/"+\
            self.ord +", Example:" + self.ex
           print(info)
mam_instance = mammalia("cetacea","whales")
mam_instance.printInfo()
```
↳ **class/order: mammal/cetacea, Example: whales**

*args and *kwargs

used to pass an unknown number of arguments to a function.
***args** is a **list**
```
def testargs (a1, *argv):
  print('arg#1: ', a1)
  for ax in range(0, len(argv)):
      print ("arg#"+str(ax+2)+" is "+argv[ax])
testargs('B', 'C', 'T', 'A')
```
↳
```
arg#1:  B
arg#2 is C
arg#3 is T
arg#4 is A
```
***kwargs** is a **keyword -> value pair**
keyword is **not** an expression
```
def testkwargs(arg1, **kwargs):
    print ("formal arg:", arg1)
    for key in kwargs:
        print ((key, kwargs[key]))
testkwargs(arg1=1, arg2="two", dog='cat')
```
```
formal arg: 1
('dog', 'cat')
('arg2', 'two')
```
Example of: function, *, *args
```
def myfunc(*args): # function unknown # args
    print(*args)
my_list = ['a1','b2','x','c3']  # create list
myfunc(*my_list)  # new list expanding old
del my_list[2]        # remove 2nd item
myfunc(*my_list)   # reprint to prove
```

NEW IN 3.10
Case Pattern Matching

"Takes an expression and **compares** its value to successive patterns given in one or more **case blocks**."
```
match value | string | list | T/F:
    case value | string | list | T/F:
        <responding code>
    case…
    case _:   # nothing matched must
              be the last case match
```
~ case can match multiple objects
~ a list case object can be unpacked *
```
    case ["paint", *colors]:
        for color in colors  ….. etc.
```
~ can capture subpattern using or/as
```
   case [x, (1 | 3 | 5 | 7) as choice]:
```

f-string Formatting

[new 3.6]

Conversion Types

'd'	Signed integer decimal.
'i'	Signed integer decimal.
'o'	Signed octal value.
'u'	Obsolete type – it is identical to 'd'.
'x'	Signed hexadecimal (lowercase).
'X'	Signed hexadecimal (uppercase),
'e'	Floating point exponential format (lowercase).
'E'	Floating point exponential format (uppercase).
'f'	Floating point decimal format.
'F'	Floating point decimal format.
'g'	Floating point format. Uses lowercase exponential format if exponent is less than -4 or not less than precision, decimal otherwise
'G'	Floating point format. Uses upper-case exponential format if exponent is less than -4 or not less than precision, decimal format otherwise.
'c'	Single character - accepts integer or single character str
'r'	String - uses repr() to convert object
's'	String - uses str() to convert object
'a'	String - uses ascii() to convert object
'%'	Puts '%' character before result

conversion flags

'#'	conversion will use "alternate form"
'0'	conversion zero padded for numerics
'-'	value is left adjusted (overrides '0')
' '	(space) Leave a space before a + or #
'+'	A sign character ('+' or '-') will precede conversion (overrides "space" flag).

Integer Bitwise Operations

Operation / Result

x | y
bitwise **or** of x and y

x ^ y
bitwise ***exclusive or*** *x and y*

x & y
bitwise **and** of x and Y

x << n
x shifted left by n bits

x >> n
x shifted right by *n* bits

~x
the bits of x inverted

www.wikipython.com

Bytes and Bytearray Operations

x. = method can be used w/ "bytes." or "bytearray." i.e., *x.count(sub[, start[, end]])* is same as *bytes.count(sub[, start[, end]])* or *bytearray.count(sub[, start[, end]])*

x.decode(encoding="utf-8", errors="strict")
x.endswith(suffix[,start[, end]])
x.find(sub[, start[, end]])
x.index(sub[, start[, end]])
x.join(iterable)
static bytes.maketrans (from, to)
static bytearray.maketrans (from, to)
x.partition(sep)
x.replace(old, new[, count])
x.rfind(sub[, start[, end]])
x.rindex(sub[, start[, end]])
x.rpartition(sep)
x.startswith(prefix[, start[, end]])
x.translate(table,/,delete=b)
x.center(width[, fillbyte])
x.ljust(width[, fillbyte])
x.lstrip([chars])
x.rjust(width[, fillbyte])
x.rsplit (sep=None, maxsplit=-1)
x.rstrip([chars])
x.split(sep=None, maxsplit=-1)
x.strip([chars])
x.capitalize()
x.expandtabs(tabsize=8)
x.isalnum()
x.isascii()
x.isalpha()
x.isdigit()
x.islower()
x.isspace()
x.istitle()
x.isupper()
x.lower()x.splitlines (keepends=False)
x.swapcase()
x.title() x.upper()
x.zfill(width)

Operators and Precedence

lambda
if – else
or · **and** · **not x** (Boolean)
in · **not in** · **is** · **is not**
< · **<=** · **>** · **>=** · **!=** · **==**
| · **^** · **&** bitwise OR, XOR, AND
<< · **>>**
+ · **-**
***** · **@** · **/** · **//** · **%** (multiply, matrix multiply, division, floor divison, remainder)
+x · **-x** · **~x** (pos, neg, bitwise NOT)
** (exponentiation)
await (Await expression)
x[index] · **x[index:index]** · **x(arguments...)** · **x.attribute** (subscription, slicing, call, attribute ref)

Built-in Types

numerics, sequences, mappings, classes, instances, exceptions

Numeric Types

int, float, complex constructors: complex(real, imaginary) *imaginary defaults to 0*

Numeric Operations

x + y	sum of *x* and *y*	**x - y**	difference of *x* and *y*
x * y	product of *x* and *y*	**x / y**	quotient of *x* and *y*
x // y	floored quotient of *x* and *y*		
x % y	remainder of x / y	**-x**	*x* negated
+x	*x* unchanged	**abs(x)**	absolute value *x*
int(x)	*x* converted to integer		
float(x)	*x* converted to floating point		
complex (real, imaginary)	imaginary defaults to 0		
c.conjugate()	conjugate of complex number *c*		
divmod(x, y)	the pair (x // y, x % y)		
pow(x, y)	*x* to the power *y*		
x ** y	*x* to the power *y*		
round(x[,n])	round to n digits, half to even		

math module (import math) adds these rounding operations: **math.trunc(x); math.floor(x); math.ceil(x)**

Escape Codes

\n	newline
\t	tab
\	backslash
\' \"	quote sgl/db
\a	ascii bell
\000	octal val 000
\xhh	hex val hh
\r	carriage return

Sequence Operations

x in s	True if an item of s is equal to x
x not in s	False if an item of s == x
s + t	the concatenation of s and t
s * n or n * s	concatenate s n times
s[i]	ith item of s, origin 0
s[i:j]	slice of s from i to j
s[i:j:k]	slice of s from i to j step k
len(s)	length of s
min(s)	smallest item of s
max(s)	largest item of s
s.index(x[, i[, j]])	index of the first occurrence of x in s (at or after index i and before index j)
s.count(x)	number of occurrences of x in s

Mutable Sequence Operations

s[i] = x	item i of s is replaced by x
s[i:j] = t	slice of s from i to j is replaced by the contents of the iterable t
del s[i:j]	removes i to j; same as ***s[i:j] = []***
s[i:j:k] = t	the elements of s[i:j:k] are replaced by those of t; start, stop, step
del s[i:j:k]	removes the elements of s[i:j:k] from the list
s.append(x)	appends x to the end of the sequence
s.clear()	removes all items from s (same as ***del[:]***)
s.copy()	creates a shallow copy of s (same as ***s[:]***)
s.extend(t) or ***s +=***	extends s with the contents of t (for the most part the same as***[len(s):len(s)] = t)***
s *= n	updates s with its contents repeated n times
s.insert(i, x)	inserts x into s at the index given by i(same as *s[i:i] = [x]*)
s.pop([i])	retrieves the item at i and removes it from s
s.remove(x)	remove the first item from s where s[i]== x
s.reverse()	reverses the items of s in place

** see: https://docs.python.org/3.10/library/stdtypes.html

Keywords (reserved)

and, as, assert, async, await, break, class, continue, def, del, elif, else, except, False, finally, for, from, global, if, import, in, is, lambda, nonlocal, None, not, or, pass, raise, return, True, try, while, with, yield

Built-in Constants

False, True, None, NotImplemented, Ellipsis (same as literal '...'), __debug__, quit(), exit(), copyright, credits, license

Boolean Operations

Operation / Result (ascending)		
x or y	if *x* is false, then *y*,	else *x*
x and y	if *x* is false, then *x*,	else *y*
not x	if *x* is false, True,	else False

BIG DADDY'S

vPro2022

www.wikipython.com *in this document the symbol ↳ means yields, results in, or produces

PYTHON TOOLBOX

For 3.6+

The Python Standard Library

Content: docs.python.org/3/py-modindex.html

Text Processing Services - 7 modules including:
string — Common string operations
re — Regular expression operations
textwrap — Text wrapping and filling

Binary Data Services - 2 modules

Data Types – 13 modules including:
datetime — Basic date and time types
calendar — Calendar-related functions
copy — Shallow and deep copies
enum — Support for enumerations
pprint — Data pretty printer

Numeric and Mathematical Modules – 7 modules including:
numbers — Abstract base classes
math — Mathematical functions
cmath - complex #; decimal - accurate
random — Generate pseudo-random #s
statistics — Statistical functions
fractions — Rational numbers

Functional Programming – 3 modules

File and Directory Access – 11 modules including:
pathlib — Object-oriented file paths
os.path — Common path functions
fileinput — iterate lines—multiple inputs
filecmp — File and directory compare
shutil — High-level file operations

Data Persistence – 6 modules including:
pickle — Python object serialization
marshal — Internal Python object serialization
sqlite3 — DB-API 2.0 interface for SQLite databases

Data Compression and Archiving – 6 modules including:
zipfile — Work with ZIP archives
tarfile — Read and write tar archive files

File Formats – 5 modules including:
csv — CSV File Reading and Writing

Cryptographic Services – 3 modules:

Generic Operating System Services – 16 modules inc:
os — Miscellaneous operating system interfaces
time — Time access and conversions
io — Core tools working with streams
platform — Accesss to platform identifying data

Concurrent Execution – 10 modules including:
threading — Thread-based parallelism
multiprocessing — Process-based parallelism

Interprocess Communication and Networking - 9 mods **Internet Data Handling –** 10 modules:

Structured Markup Processing Tools – 13 modules:

Internet Protocols and Support - 21 modules

Multimedia Services – 9 modules including:
wave — Read and write WAV files

Internationalization – 2 modules:

Program Frameworks – 3 modules including:
turtle — Turtle graphics

Graphical User Interfaces with Tk – 6 modules including:
tkinter — Python interface to Tcl/Tk
IDLE

Development Tools – 9 modules:

Debugging and Profiling – 7 modules:

Software Packaging and Distribution – 4 modules NOTE: distutils deprecated - Setuptools now includes it
ensurepip — bootstrapping pip installer

Python Runtime Services – 14 modules including:
sys — System-specific parameters and functions
sysconfig — Access to Python's config information
__main__Top-level script environ.
inspect — Inspect live objects

Custom Python Interpreters – 2 mods

Importing Modules – 5 modules including
zipimport — Import modules from Zip archives
runpy — Locating and executing Python modules

Python Language Services – 13 mods :
keyword — Testing for Py keywords
py_compile — Compile Python source files

Miscellaneous Services – 1 module:

MS Windows Specific Services – 4 modules

Unix Specific Services - 13 modules:

Superseded Modules – 2;

Undocumented Modules – 1

pypi.org another 257M+ modules including: RPI.GPIO, Pillow, pandas, fuzzywuzzy, Anaconda, miniconda, conda, playsound, Poetry, Numpy, etc.

To find installed modules from Python:
>>> help('modules')

Selected Standard Library Module Constants and Methods for New Users

calendar import calendar
a couple of fun examples:
c=calendar.**TextCalendar**(calendar.SUNDAY)
c.pryear(2021,w=2,l=1,c=6,m=3) **or try**
c=calendar.**TextCalendar**(calendar.MONDAY)
c.setfirstweekday(calendar.SUNDAY)
print(c.formatmonth(2021,1,w=0,l=0))
many functions - **see: www.wikipython.com** -> OTHER MODULES -> calendar

cmath **-** A suite of functions for complex #

copy - import copy relevant for compound objects, (objects containing other objects)
.**copy**(x) <-relies on references to objects
.**deepcopy**(x[, memo]) <-copies objects (so you can change the copy and not the original)

csv See **Data on Disk Toolbox**

datetime from datetime import *
hundreds of functions and attributes
today = date.today()

decimal fast, correctly rounded fp math with a gazillion functions and pages of instruction

ensurepip **-** boostrap pip into an existing Python environment - pip is the installer for modules **not in the Standard Library**
Windows **command line invocation**:
python –m ensurepip -- upgrade

enum - from enum import enum
mimicks enum in C, fast integer access and iter.

filecmp import filecmp
.cmp(f1, f2, shallow=True) Compare f1 and f2, returning True if they seem equal

fileinput import fileinput
for line in fileinput.input()**:**
your code to process(line)
.**input** (files=None, inplace= False, backup="", *, mode='r', openhook=None)
.filename() ↳ file being read
.fileno() ↳ file descriptor (-1 is none open)
.**lineno**() ↳ cumlatiave # of last line read
.**filelineno**() ↳ line # in current
.**isfirstline**() ↳ True if first line of its file
.**isstdin**() ↳ True if last line was read from sys.stdin
.**nextfile**() close file, read next line from next file
.**close**() close

fractions.py import fractions
.Fraction (numerator=0, denominator=1)
.Fraction(other_fraction)
.Fraction(float) **.Fraction**(decimal) **.Fraction**(string)
a= '3.03125' **;** print(fractions.Fraction(a)) ↳ 97/32
print(fractions.Fraction(3.14159))
↳ 3537115888337719 **/** 1125899906842624

idlelib IDLE is Python's native IDE see:
https://docs.python.org/3.10/library/idle.html

io import io**:** three types: text, binary, raw *Ex:*
f = open("myfile.txt", "r", encoding="utf-8")
f = open("myfile.jpg", "rb")
f = open("myfile.jpg", "rb", buffering=0)

json - See **Data on Disk Toolbox**

math - import math functions include:
.**ceil(x)** *smallest int >= x*
.comb(n,k) *ways to choose k items from n*
.copysign(x,y) *absolute value of x, sign of y*
.fabs(x) ↳ *absolute value of x*
.factorial(x) ↳ *x factorial as integer*
.floor(x) ↳ *largest int <= x*
.fmod(x,y) *mathematically precise ver of x%y*
.frexp(x) ↳ *mantissa and exponent of x (m,e)*
.fsum(iterable) *returns fp sum of values*
.gcd(a,b) ↳ *greatest common divisor of a & b*
.isclose(a, b, *, rel_tol=1e-09, abs_tol=0.0) *True if a & b are close, otherwise False, relative or abs tolerance*
.**isfinite**(x) ↳*True if x not infinity or a NaN*
.isinf(x) *True if x is a positive or negative infinity*
math.isnan(x) ↳ True if x is a NaN (not a number), False otherwise.
[new 3.8] **.isqrt**(n) ↳*the integer square root of the nonnegative integer n. This is the floor of the exact square root of n, or equivalently the greatest integer such that a² ≤ n. To compute the ceiling of the exact square root of n, a positive number, use a = 1+ isqrt(n - 1).*
.ldexp(x, i) ↳ *x * (2**i); inverse of **frexp**()*
.modf(x) ↳ fractional and integer parts of x
.trunc(x) ↳Real value of x truncated to integral
.exp(x) ↳ e**x. **.expm1**(x) ↳ e**x - 1
.log(x[, base]) 1 argument, ↳ natural logarithm of x (to base e). 2 arguments, ↳ the logarithm of x to the given base, calculated as log(x)/log(base).
.log1p(x) ↳ the natural logarithm of 1+x (base e). *accurate for x near zero*
.log2(x) ↳ the base-2 logarithm of x
.log10(x) ↳ base 10 log of x
.pow(x,y) ↳ x raised to y
.**sqrt**(x) ↳ square root of x
Trigonometric Functions: ↳**radians** **.atan2**(y,x)
.hypot(x,y) ↳ sqrt(x*x + y*y) **.acos**(x) **.asin**(x)
.atan(x) **.cos**(x) **.sin**(x) **.tan**(x)
.degrees(x) anglex from radians to degrees
.radians(x) anglex from degrees to radians
math.pi π = 3.141592… **math.e** e = 2.718281…
math.nan A floating-point "not a number" (NaN)

numbers - operations from abstract base classes - four classes defined: Complex(components: real, imaginary), Real, Rational (adds numerator and denominator properties), Integral

os import os ****hundreds of functions, many**

os specific; a few universal
.**environ**['HOME'] *home directory*,
.**chdir**(path) change working dir
.**getcwd**() current working dir
.**listdir**(path) .**mkdir**(path) .**mkdirs**(path) *make all intermediate directories* .**remove**(path)
.**strerror**() translate error code to message
.**curdir**() .**rename**(src, dst) .**rmdir**(path)
.**walk**(start directory, topdown=True) produces a generator of filenames in a directory tree
.**system**(command) Unix and Windows, execute the command in a subshell

os.path ***Lib/posisxpath** or **Lib/ntpath** (windows)*
import os.path [as osp]
.**abspath**(*path*) normalized absolutized version of the pathname *path*.
.**basename**(*path*) base name of pathname *path*.
.**commonpath**(*paths*) longest common sub-path.**commonprefix**(*list*) ↳ the longest prefix
.**dirname**(*path*) ↳ directory name of *path*
.**expandvars**(*path*) ↳ *environment variables expanded*
.**exists**(*path*) ↳ True if *path* exists
.**getsize**(*path*) ↳ n the size, in bytes, of *path*.
.**isabs**(*path*) ↳True if *path* is absolute pathname
.**isfile**(*path*) ↳ True if *path* is existing file
.**isdir**(*path*) ↳ True if *path* is existing directory
.**islink**(*path*) ↳True if ref is an existing directory
.**join**(*path*, **paths*) Join one or more path components intelligently.
.**normcase**(*path*) Normalize case of a pathname
.**normpath**(*path*) On Windows, converts forward slashes / to backward slashes \.
.**relpath**(*path*, *start=os.curdir*) ↳ relative filepath from the current directory or an optional start
.**samefile**(*path1*, *path2*) ↳ True if both pathname arguments refer to the same file or directory.
.**sameopenfile**(*fp1\fp2)* ↳ True if the same
.**samestat**(*stat1*, *stat2*) Return True if the stat tuples *stat1* and *stat2* refer to the same file.
.**split**(*path*) Split *path* into a pair, (head, tail)

pathlib (3.5) from pathlib import Path [as pt]
SEE **DATA ON DISK TOOLBOX**—this is now THE critical file access module

pickle import pickle - non-human-readable
See **Data on Disk Toolbox**

platform import platform
.**machine**() ↳ *machine type*
.**node**() ↳ *network name*
.**processor**() ↳ *real processor name*
.**python**_version ↳ *version as string*
.**system**() ↳ *'Linux', 'Darwin', 'Java', 'Windows'*

pprint import pprint
allows output of objects, including objects holding other objects in a reasonably readable format. Begin by creating an instance: (assume "mylist")
pp = **pprint.PrettyPrinter**(indent=3) *set indent*
then use your instance ("pp" above) to output:
pp.**pprint**(mylist)
some PrettyPrinter objects new/changed in **[3.8]**
.pformat(obj), .pprint(obj), pp.isreadable(obj), more
ex: print(pp.**isreadable**(mylist))

py_compile.py import py_compile
.**compile**(file) - the compiled file is placed on file path in added directory "/__pycache__/ "

random import random
*only for **non-cryptographic** applications*
.**seed** initialize the random number generator
.**getstate**() ret object with internal generator state
.**setstate**() restores internal state to getstate value
.**getrandbits**(k) ret integer with k random bits
For **integers**: .**randrange**(start, stop[, step])
.**randrange**(stop) .**randint**(a, b) a random integer N such that a <= N <= b. Alias for randrange(a, b+1).
For sequences:
.**choice**(sequence) ↳ random element
.**random**() ↳ the next random floating point number in the range (0.0, 1.0).

.**uniform**(a, b) ↳ a float between a and b

re import re complex search and match
re.**search**(pattern, string, flags=0)
re.**match**(pattern, string, flags=0)
re.**ignorecase**

shutil import shutil
.**copyfileobj**(fsrc, fdst[, length])
.**copyfile**(src, dst, *, follow_symlinks=True)
.**copymode**(src, dst, *, follow_symlinks=True)
Copy the permission bits from src to dst.
.**copystat**(src, dst, *, follow_symlinks=True)
Copy the permission bits, last access time, last modification time, and flags from src to dst
.**copy**(src, dst, *, follow_symlinks=True)
Copies the file src to the file or directory dst. src and dst should be strings.
.**copy2**(src, dst, *, follow_symlinks=True)
copy2() also attempts to preserve file metadata
.**copytree**(src, dst, symlinks=False, ignore=None, copy_function=copy2, ignore_dangling_symlinks=False, dirs_exist_ok=False)
.**disk_usage**(path) ↳ disk usage stats as tuple (total, used and free) in bytes—a file or a directory

Sound if your objective is to play a sound using a Python Standard Library module save your time - **none** of the modules listed under Multimedia Services do that. SEE: PyPi — playsound

sqlite3 See **Data on Disk Toolbox**

statistics import statistics
.**mean**(data) average
.**harmonic_mean**(data) harmonic mean
.**median**(data) middle value
.**median_low**(data) low middle value
.**median_high**(data) high middle value
.**median_grouped**(data) 50th percentile
.**mode**(data) most common
.**pstdev**(data,mu=None) population std dev
.**pvariance**(data,mu=None) pop variance
.**stdev**(data, xbar=None) sample std dev
.**variance**(data, xbar=None) sample variance
more...extensive normal distribution functions

string

Constants		
	string.ascii_letters,	
	string.ascii_lowercase	string.ascii_uppercase
	string. digits	string.hexdigits
	string.octdigits	string.punctuation
	string.printable	string.whitespace
	string.capwords(str, sep=None)	

sys import sys mostly advanced functions
.**exit**([arg]) - exit python; .**getwindowsversion**()
.**path** - search paths list; .**version** - Python version

tarfile import tarfile extensive archive including gzip, bz2 and lzma compression
ex: (assumes import tarfile – to extract to cwd)
tar = tarfile.**open**("sample.tar.gz")
tar.**extractall**() ; tar.**close**()

textwrap import textwrap
textwrap.**wrap**(text,width=x,**kwargs)**Lib/Lib/**

time import time or from time import
a new user must understand terminology found at:
https://docs.python.org/3.8/library/time.html
print(time.**time**()) #seconds since the epoch
↳ 1596486146.111275
mytime = time.**time**() #capture it
print(time.**localtime**(mytime)) #demo the tuple
↳ time.struct_time(tm_year=2020, tm_mon=8, tm_mday=3, tm_hour=16, tm_min=22, tm_sec=26, tm_wday=0, tm_yday=216, tm_isdst=1)
time_tuple=time.**localtime**(mytime) #capture it
print("The hour is: " + str(time_tuple[3])) #demo
↳The hour is: 16
print(time.**strftime**("%a, %d %b %Y %H:%M:%S +0000", time.**gmtime**()))
↳Mon, 03 Aug 2020 20:22:26 +0000
seconds=5 ; print("Wait 5 seconds!")
time.**sleep**(seconds) # delay of five seconds
print(time.**asctime**(time.localtime()))
↳ Mon Aug 3 16:22:31 2020
print(time.**ctime**(mytime))
↳ Mon Aug 3 16:22:26 2020

tkinter from tkinter import * a **16** page **tkinter Toolbox** is available for review at **www.wikipython.com**—free download on GitHub
a better (?) option : see PySimpleGUI below

A Few PyPi Modules

https://pypi.org

Anaconda, Conda, MiniConda - 3 related programs offering environment management at different levels. **Anaconda** manages all variations and compatibility issues unavoidable with many modules. Over 300 applications come "installed" in the base (root) environment, with thousands available. **Installation(s) can be huge.** It qualifies as a language within itself. Numerous IDEs are available in any Anaconda environment including Spyder, Visual Studio Code, IDLE, Jupyter Notebooks ... more. **Miniconda** is a lightweight version. **Conda** is similar to pip but is also an environment manager.

NumPy - powerful **N-dimension array** objects
NumPy says installation works best with a prebuilt package, see: https://scipy.org/install.html where they suggest a "scientific distribution" but do give **pip** directions

Rpi.GPIO – module to control Raspberry Pi GPIO channels; see GPIO toolbox and download link at: **www.wikipython.com**

Pillow - by Alex Clark, updated Aug 2020, a friendly version of Fredrik Lundh's **Python Imaging Library**
Pillow version 7.2 works in Python 3.5 to 3.8
install: **python3 -m pip install --upgrade Pillow**
from PIL import Image
im = Image.**open**(testfilepath)
print(im.**format**, im.**size**, im.**mode**)
im.**show**()

PySimpleGUI for high production in a reasonable time frame PySimpleGUI—a wrapper for tkinter and other platforms—is simply a better mousetrap. It powerfully trivializes GUI development for programmers who do not want to specialize in just the graphics of API design.

playsound is a cross platform program pulled from **Pypi** that is very easy to use. From windows:
python -m pip install playsound for example:
from playsound import playsound
testwave = "C:\\Windows\\Media\\Alarm09.wav"
playsound(testwave)

pandas for tabular data — "aims to be the fundamental" module for "real world data analysis" - it is part of the Anaconda distribution (also installs with Miniconda) but can be installed with pip:
pip install pandas

plotly.express and Kaleido - **plotly.express** is built-in to the **plotly** library and is considered a "starting point" but may be all you ever need. *Plotly is an MIT Licensed module.* plotly.express requires a determined effort to learn because it creates more than 35 types of graph images. It does **not** export your graph as a static image—which is why you need **Kaleido**. plotly has many dependencies, kaleido has none.
pip install kaleido.

Module Management

import get module, ex: import math **or**
from module import *
from get a single module function: from math import cos; print (cos(9))
as creates an alias for a function

What is NOT mentioned in this General Toolbox?
About 99.83% of Python capability now available has no mention in this toolbox. Happy Coding!