Python-in-8 pages

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1. Basics: A. Datatypes & Conversion

SL	Category / Datatype	Variable declaration	Class	Type Conversion
1	Numeric – **int, float, complex**	v1 = 1 # *int* | v2 = 1.0 # *float*	type(v1) <class 'int'>| type(v2) <class 'float'>	**int()** | **float()**
2	Text – **String**	v3 = "apple"	type(v3) is <class 'str'>	**str()**
3	Sequence – **List**	v4 = ['apple','banana','cucumber']	type(v4) is <class 'list'>	**list()**
4	Sequence – **Tuple**	v5 = ('apple','banana','cucumber')	type(v5) is <class 'tuple'>	**tuple()**
5	Set – **Set, Frozenset**	v6a={'apple','banana'}|v6b=set((1,2,3))	type(v6a | vb6) is <class 'set'>	**set()**
6	Mapping – **Dictionary**	v7 = {'apple':1,'banana':2,}	type(v7) is <class 'dict'>	**dict()**
7	Boolean – **bool**	v8 = True	type(True) is <class 'bool'>	**bool()**
8	Others – (Binary, None)	(Binary) **bytes, bytearray, memoryview**, (None type) **None**		

Type Conversions	Example	Note
Data Type Checking	print(True if **type([var4])==list** else False) >> True	same for all types – **int, str, set, dict, tuple, float.bool**
Float to Int | Int to Float	**int(1.122)** >> 1 | **float(1)** >> 1.0 | **format(1, '.3f')** >> 1.000	**type(format(1, '.3f')) >> str** (and not float)
int/float to string	**str(1.233)** >> 1.233 | **str(1)** >> 1 | print([str(1)]) >> ['1']	quotes doesn't not appear, unless used in list/set/dict
string to int/float	**float('1.222')** >> 1.222 | **int('1.222')** >> error | **int('1')** >> 1	To convert floating string to int follow **Str->Float->Int**
str to list	**list('Joydeep')** >> ['J', 'o', 'y', 'd', 'e', 'e', 'p']	**list(str)** splits all characters & returns a list of all chars.
str to tuple	**tuple('Joydeep') >> ('J', 'o', 'y', 'd', 'e', 'e', 'p')**	**tuple(str)** returns list of all chars in a tuple
str to set	**set('joydeep basu') >>** {'s', 'y', 'd', ' ', 'u', 'e', 'j', 'p', 'o'}	**set(str)** returns all **Unique chars** as set items.
str to set to list	**list(set('joydeep basu')) >>** ['s', 'y', 'd', ' ', 'u', 'e', 'j', 'p', 'o']	**list(set(str))** returns a **list of unique chars** in string.
Iterables to dictionary (iterable= str/list/tuple)	**1. {k:v for k,v in enumerate(ite, *start*=0)}** *(ite: str/list/tuple)* **2. {i:ite[i] for i in range(len(ite))}**	**dict** comprehension on **string/list** returning a dictionary with char **Index**:**value** as **key:value** pair
dict keys/values to list	**list({1:'Joy', 2:'Pa',3:'Tia'})** >> [1, 2, 3] **list({1:'Joy', 2:'Pa',3:'Tia'}.values()) >>** ['Joy', 'Pa', 'Tia']	**list(dict1)** returns all keys as list. **list(dict1.values())** returns all dictionary values as list.
dict keys/values to tuple	**tuple({1:'Joy', 2:'Pa',3:'Tia'})** >> (1, 2, 3) **tuple({1:'Joy', 2:'Pa',3:'Tia'}.values())** >> ('Joy', 'Pa', 'Tia')	**tuple(dict1)** >> all dictionary keys as tuple. **tuple(dict1.values())** >> all dictionary values as tuple.

B. Operations

Operations	Example	Variable	Note
Addition (+) Subtraction (-) Multiplication (*) Division(/)	2 + 2 = 4; 5 - 2 = 3; 3 * 3 = 9; 22 / 8 = 2.75;	Increment	**var += 1 >>** var = var + 1
Exponent (**)	**2 ** 3 = 8 | pow(2,3) = 8**	Decrement	**var -= 1 >>** var = var - 1
LCM & GCD (Math module)	arr1: [2, 3, 5, 6] | **math.lcm(*arr1)** >> 30 arr2: [24, 48, 36, 96] | **math.gcd(*arr2)** >> 12	Multiply	**var *= 1 >>** var = var * 1
Integer division (//)	**22 // 8 = 2 | divmod(22,8)[0] = 2**	Divide	**var /= 1 >>** var = var / 1
Modulus/Remainder (%)	**22 % 8 = 6 | divmod(22,8)[1] = 6**	Mod	**var %= 1 >>** var = var % 1
Comparison & logical operators	(Comparison) **==** Equal to, **!=** Not equal to, **<, >, <=, >=** (logical) **and, or, not**		

C. Python Built-in Functions

Category	Built-in Functions
Create **new variable** or **Type conversion**	**list(), tuple(), set(), dict(), bool(), float(), int(), str(), type()**
Change **Number system**	**bin(),oct(),hex()** → Converts an **integer number** to a binary/Octal/Hexadecimal (lowercase) **string**.
General - **Common** functions	**print()** – for printing, **input()** – to take user input in string format, **import()** – invoked by import statement, **len()** – measure element length in a iterator, **open()** – open a file (text stream)
Numbers operations (*for **Math** functions like ceil, floor – math library to be imported)	**abs()** - absolute value of a number. | **divmod()**>Returns quotient, remainder tuple | Float number rounding: **round()**, **ceil(), floor()** | **pow()** – x to the power y.| **sum(),max(),min()** – [sum|max|min] of iterable element. | **complex()** - Return a complex number with the value **real**+**imaginary***1j.
String built-in functions	**ord()** Returns **ascii code** of a character (**char->ascii**). Ex. **ord('a') >> 97**; **ord('A') >> 65** **chr()** Returns a **character** from its ascii value (**ascii->char**). Ex. **chr(97) >> a; chr(65) >> A** **ascii()** Return a string > **printable representation** of an object. **ascii('a') >> 'a'; ascii('A') >> 'A'** **format()** Convert a value to a "formatted" representation. Ex. **print(format('1', ".3f"))** >> 1.000 **round()** Return number rounded to ndigits precision after the decimal point. **slice()** Return a sliced object representing a set of indices. Takes 3 params (**start, end, step**).
Module **namespace** **Runtime variables** in scope functions	**dir()** Return the list of names in the current local scope. **id()** Return the "identity" of an object. **globals()** Return the dictionary implementing the current module namespace. **locals()** Update and return a dictionary with the current local symbol table. **vars()** Return the dict attribute for any other object with a dict attribute.
Encoding/Decoding functions	**bytes()** - Return a new "bytes" object. | **bytearray()** - Return a new array of bytes. **hash()** - Return the hash value of the object.
Dynamic execution or evaluate expression	**eval()** - Evaluates and executes an expression. | **exec()** - Dynamic execution of Python code.
Execution & **Debugging** functions	**exit()** - Exits the whole execution when called. | **help()** - Invoke the built-in help system. **breakpoint()** – Pauses code execution & starts debugging **compile()**- Compile the source into a code or AST object.

Class Built-in functions

isinstance() Return True if the object argument is an instance of an object.
issubclass() Return True if class is a subclass of classinfo.
hasattr() True if the string is the name of one of the object's attributes.
(get/set)attr() Return/set the value of the named attribute of object.
delattr() Deletes the named attribute, provided the object allows it.
super() Return a proxy object that delegates method calls to a parent/sibling

repr() Returns printable **string representation** of an object.
object() Return a new featureless object.
callable() Return True if the object argument is callable, False if not.
property() Return a property attribute.
classmethod() Transform a method into a class method.
staticmethod() Transform a method into a static method.

2. Iterables/Collection Datatypes

A. Common Operations

Operation	String	List	Tuple	Set
length count	**len()**	**len()**	**len()**	**len()**
Specific element **count**	<string>.**count**(ele)	<list>.**count**(ele)	<tup>.**count**(ele)	always **1**. (**unique**).
Element position (**index**)	s.**index**(e) | s.**rindex**(e)	l.**index**(e)	t.**index**(e)	NA (**un-ordered**)
Element **Type** determine	is(decimal|digit|alpha..)	is(decimal|digit|alpha)	is(decimal|digit|alpha)	is(decimal|digit|alpha)
Slicing iterable	**[start : end : step]**	**[start : end : step]**	**[start : end : step]**	NA. (**unordered**)
Replication (Multiplication)	str1=**ele*multiplier**	lst=**[ele]*multiplier**	tup1=**(ele,)*multiplier**	NA. Set items are **unique**.
Reverse iterable	str=**str[::-1]**	lst=**lst[::-1]** | lst.**reverse()**	tup=**tup[::-1]**	NA. (**unordered**)
Concatenation (2 or more)	(+) operator. **str1+str2**	(+) operator. **lst1+lst2**	(+) operator. **tup1+tup2**	(**union**) **set1.union(set2)**
Copy (from another)	(=) operator. **str2=str1**	<olst>**.copy()** | **list(**olst)	tup2=**tuple(**tup1)	s2=s1.**copy()** | s2=**set(s1)**
Clear all elements	**str1=""**	lst.**clear()** | lst=**[]**	tup=**tuple()** | tup=**()**	set1.**clear()** | set1=**{}**
Del iterable	**del str1**	**del lst1**	**del tup1**	**del set1**
Add a new element by **name**	(+) operator. **str1+=**ele	ls.**append(**ele) | **ls+=[**ele]	(+) operator. **tup+=(**ele,**)**	(**add** method) s1.**add(**ele)
Remove element by **name**	NA. Use **replace()/regex**	l1.**remove(e)**	NA. workaround: **via List**	s1.**remove(e) | discard(e)**
Remove element by **index**	**str1[0:i]+str1[i+1:]**	del l[i] | l.pop(i) | l[:i]+l[i+1:]	**tup1[0:i]+tup1[i+1:]**	NA. (**Un-ordered**)
Update element by **index**	**str1[0:i]+'e'+str1[i+1:]**	**lst1[0:i]+[e]+lst1[i+1:]**	**tup1[0:i]+(e,)+tup1[i+1:]**	NA. (**Un-ordered**)
Insert ele. at specific **index**	**str1[0:i]+'e'+str1[i:]**	**lst1[0:i]+[e]+lst1[i:]**	**tup1[0:i]+(e,)+tup1[i:]**	NA. (**Un-ordered**)

B. Specific Methods

1. String (specific)	Methods / Syntax	
Case switching	('**capitalize**', 'Joydeep basu')|('**casefold**', 'joydeep basu')|('**swapcase**', 'jOYDEEP basu')|('**title**', 'Joydeep Basu')|('**upper**', 'JOYDEEP BASU')|('**lower**', 'joydeep basu')|('**istitle**', False)|('**isupper**', False)|('**islower**', False)	
Searching Substring	**First** occurrence: s.**find**(e) | last (reversed) : s.**rfind**(e)	s.**find(e,start,end)** returns **-1** if e not found
Character type determination	**isdecimal**(), **isdigit**(), **isnumeric**(),**isalnum**(),**isalpha**()	**isidentifier**(), **isascii**(), **isprintable**(), **isspace**()
String **split/join** (list/set/tuple)	s.**split(**delimiter**)** >> **list** (default) | **rsplit**() | s.**splitlines**()	<delim>.**join**(iterable) | <ite>.**join**(map(str, ite))
String **replace** (substitute)	s.**replace(**old_value, new_value, count[=*all occurrences*]**)**	Note: An alternative of regEx **sub()**
String **Stripping** & **Filling**	Strip: **strip** (both side) | **lstrip** (left) | **rstrip** (right)	Fill: s.**center|ljust|rjust**(width,char), s.**zfill**(char)
String **Translation**	txt.**translate(str.maketranslation(from, to**, omit))	Here **(from,to)** is a **ascii map** used in translation
Others methods	s.[r]**partition(**delim), s.**startswith|endswith(**delim)	
2. List (specific)	Methods / Syntax	
All **list supported methods**	**count(), index(), remove(), clear(), append(), extend(), insert(), reverse(), copy(), pop(), sort()**	
Elements **Sorting**	**sort()** – sorts a list. Ex. **lst1.sort()**	lst1=lst1.sort() is WRONG! Only, **lst1.sort()** is OK.
Reversing list	**reverse() –** lst1.**reverse()** or lst1=**lst1[::-1]**	lst1=lst1.reverse() is Wrong! Just, **lst.reverse()**
Remove element (by value or index)	l.**remove(val)** (throws error if not found) | l.**remove(lst[idx])** | **del** l[idx] | l.**pop(idx)** | **lst=lst[:idx]+lst[idx+1:]**	
Insert a new element	lst.**insert(index,element)**	Alternatively, use slicing: **lst[idx:idx]=[ele]**
3. Tuple (specific)	Methods / Syntax	
All **tuple supported methods**	**index(), count()** [and **slicing** works same as list.]	
Add/Remove/Insert/Delete/.., Alternative of slicing ("**via List**")	Tuples are **Immutable**, but can easily be converted into **lists** which is **Mutable**. So these operations can be performed "**via List**" i.e. **tup=(1,2,3,) → lst=list(tup) →** lst.**insert|remove|pop|append**() **→ tup = tuple(lst)**	
4. Set (specific)	Methods / Syntax	
Basic **element** operations on set	**add()→**(new item)**, remove()→**(specific item), **discard(), pop()→**(random item)**, clear(), copy()**	
Combined distinct items of set1&2	**union() →** set1.**union(set2)** or set1 **|** setB	**update()** – updates **union** on set1
Common items of both set1&2	**intersection() →** set1.**intersection**(set2) or set1 **&** set2	**intersection_update()** – updates **inter..** on set1
Combined Unique items of set1&2	**symmetric_difference() →** set1.**s..d..**(set2) or set1^set2	**symmetric_difference_update()** – updates (←)
Unique items of set1 NOT in set2	**difference() →** set.**difference**(set2) or set1 **-** set2	**difference_update() –** updates **diff..** on set1
Check whether **Set1.method(Set2)**	**isdisjoint() -** (no intersection?)**, issubset()** (s1 if s.s of s2)	**issuperset()** whether set1 having all set2 items
Create a **Frozenset** (immutable set)	**frozenset() → fset1 = frozenset(iterable)**	Note: frozenset has no **add/remove** methods
5. Dictionary (specific)	Methods / Syntax	
Create new Dict. from list/tup (keys)	d1=**dict.fromkeys(**iterable, default value**) | Iterable:** tuple/list of **keys** | Value: can be anything, **0** | **[]** | **None**	
Copy from a dictionary	**d2=d1.copy()** or **d2=dict(d1)**	**d2=d1** with just create a name ref. & not a copy.
Get **key/value/items** list	**keys() → list** of all keys **| values() → list** of values	**items()** → returns a **list** of (key, value) tuple
Set/Get/Update value by key	**d1[key] = val** | **d1.get(key)** | d1.**update({key:val})**	**clear()** → clear all **keys & values** of a dict (reset)
Remove/Pop element	x=d1.**pop(key**, *[return value if key missing]*)	**popitem()** removes the **last key** & returns **(k,v)**
Return **default** value if key missing	d1={1:10,2:20}; d1.**setdefault(2,25)** will return **20** but **d1.setdefault(3,35)** will return **35** as key **3** is missing.	

C. Built-in Functions

Iterator Functions	Description	Example/Note
sorted()	Return a **new sorted list** from the items in iterable.	**[x for x in sorted(tup, key = lambda x: x[idx])]**
enumerate()	Takes a **collection**-adds a **counter** (key)-return **enumerate object**	**d1={k:v for k,v in enumerate(str/tup/lst, *start*=0)}**
filter()	Removes un-matched elements from iterable. **list(filter(lambda x: x>=10 and x<=80, [5,10,20,70,90]))** >> **[10, 20, 70]**	
reversed()	Return a reverse iterator object. Use list()/tuple() to extract items	**list(reversed([1,2,3,4,5])) >> [5,4,3,2,1]**
map()	Return an iterator that applies function to every item of iterable.	Syntax: **map(function to apply on each, iterable)**
lambda()	**Single line anonymous function** defined without any name.	res = list(map(**lambda x: pow(x,2)**, iterable))
all()	Return True if **all elements of iterable** are **true**. *l3= [10,20,30];* ***all****(map(lambda x: True if x%3==0 else False,l3))* >> ***False***	
any()	Return True if **any element of iterable** is **true**. *l3= [10,20,30];* ***any****(map(lambda x: True if x%3==0 else False,l3))* >> ***True***	
zip()	Iterate over several iterables in parallel.	**res={k:v for k,v in zip(lst1,lst2)}** *(len(lst1)=len(lst2))*
iter() | aiter() **next()**	Return an **iterator** object. [**aiter()** for **asynchronous** object] | **next()** Retrieve the **next item** from the iterator. For example, x = **iter(["Joy", "Deep", "Basu"]) | type(x)** >> <class '**list_iterator**'> | **next(x)** > Joy; **next(x)** > Deep; **next(x)** > Basu	

3. Topics:

A. Comprehensions

1	**If-else**	print(True **if len(x) >= 7 else** False) | print(True) **if len(x)>=7 else** print(False)	if condition can be nested.
2	**List**	l1 = **[x for x in iterable if x%2==0]** l2= **[odd.append(x) if x%2!=0 else even.append(x) for x in iterable if x<100]**	Condition can be placed in both with expression & iterator loop
3	**Dictionary**	odict = **{x:x**3 for x in input if x % 2 == 0}**	{k:v for (k, v) in iterable if (cond)}
4	**Set**	oSet = **{x for x in input if x % 2 == 0}**	
5	**Generator**	print(**x for x in input if x % 2 == 0**) >> Prints a <**generator object**>, use type conversion **list()/tup()/set()** on this.	

B. Conditional Statements

1	**if…elif…else**	**General if <condition1>: \n <code> elif <cond2>: \n <code> elif <cond3>: \n <code> \n else: \n <code>**
2	**match…case**	Python **v3.10** supports **match <exp>** \n **case <val>: <code>** \n **case <val>: <code>** \n **case default**: <code>

C. Functions & Arguments

1	**Function as "Object"**	**Any custom name (here, cf) can be assigned on a lambda function to use that function as object.** **Ex: cf=lambda x,y,z: x+y-z | print(cf(10,20,5)) >> 20 | Note: lambda() doesn't require a return keyword.**	
2	**Function** as "**argument**"	def **add(x, y)**: return **x + y** | def **sub(x, y)**: return **x - y** | def **ope**(**func**): return **func**(100,20) **list(map(ope, [add, sub]))** returns **[120, 80]** | Here, function **add** and **sub** are passed to **ope** as "argument".	
3	**Function** as "**return value**"	def **master**(**ope**): def **add**(x, y): **print(x + y)** def **sub**(x, y): **print(x - y)** return **eval(ope)**	**x = master('add')** # here, **x** is the '**add**' function returned by **master** **y = master('sub')** # here, **y** is the '**sub**' function returned by **master** Now, calling → **x(5,9)** will print **14** And calling → **y(10,5)** will print **5**
4	***args** vs ****kwargs** and **Optional/default** argument	To pass **unknown/arbitrary number of arguments (*args)** or **keyword arguments (**kwargs)** in a function. **Default arguments** are passed with a **value**, so, if not provided during function call it will use the default value.	

D. Loops

1	**for x in range(start,end,step)**	**for x in range(0,0) → doesn't loop | for x in range(0,1) → loops for x=0 | for x in range(len(iterable))** **for x in range(0,10,2) → loops for x=0,2,4,6,8 (as increment step is s) | Note: loop runs for x=start,,,end-1**
2	**for x in iterable**	**tuple(0,0)**: for x in **(0,0)** | **list**: for x in **[0,1,0]** | **dict:** for x in d.**keys()|values()** | for x in **enumerate(txt)** | etc.
3	**for else** loop	If for loop faces a **break** statement it does NOT execute the **else** part. Otherwise, **else part** is executed **after all for loop iterations**.
4	**while** loop	**while condition → while True** executes the loop but **while None** doesn't execute the loop **lst=[]**; while **lst**: print(True) → this loop will not run because **lst is empty** >> **while None**:
5	**break** vs **continue**	**break → exits the loop** immediately when meets breaking condition. **continue → skips** the **remaining loop statements** and goes to the **next iteration** of the loop.

E. Class-Object-OOPs

1	Class **&** Object	**A** Class **is a like a** blueprint/prototype **for an object and an** Object **is an** instance **of a class.**		
2	**Instance** vs **class** components **methods-attributes-keyword**	**1. Keyword**	**cls** for class	**self** for instance/object
		2. **Decorator**	**@classmethod**	NA
		3. **Access** class v instance methods & attributes	**cls./self.** (from inside or within class) **className.** <method/attr> (outside)	**self.**<method/attr> (from inside) **objName**.<method/attr> (outside)
3	**Constructor (__init__)**	Calling a class first invokes the **constructor __init__()** method. **super().__init__()** is **parent class** constructor.		
4	**Access Modifiers** on method/attributes	Three – 1.**Public**|2.**Protected**|3.**Private** → starts with 1.**No**|2.**Single**|3.**Double** underscore and accessible from 1. **anywhere of the program** | 2. **Class & inherited child classes** |3. **the defining class only**.		
5	OOP > **Inheritance**	**Super/Parent/Base** class being inherited by **Sub/Child/Derived** class to inherit parent methods & attributes		
6	OOP > **Multiple Inheritance**	Python allows Multiple Inheritance by a child class but it follows **M**ethod **R**esolution **O**rder **(MRO).**		
7	OOP > **Encapsulation**	Class as a grouping or '**Wrapper**' of all **variables & Methods** declared inside it.		
8	OOP > **Polymorphism**	1. Same **Base class methods** being **overriden differently** by inherited subclasses. 2. Same **class method** results differently for **different data types.** Ex. **+** operator → Addition-Concatenation		
9	OOP > **Abstraction**	1. from **abc** import **ABC**, **abstractmethod** 2. use **@abstractmethod** decorator above base/parent class method and **pass** in the body | 3. **override** the same method from **child** class.		

F. Closures & Decorators

1	**Decorator**	To execute **pre-requisite methods/events** on **before/after** the **original** function decorators are used.
2	**Closure**	Closure is like **function as Object**, an **inner function** defined inside of **outer** function.
3	Decorator **implementation**	1. **Function** as **decorator**, 2. **Class** as **decorator** (see example later)

G. Error Handling

1	Exception **Raising**	**1.** raise Exception**|**ErrorType**(error_msg) | 2.** assert(condition) **→ error is thrown if condition is not TRUE.**
2	Exception **Handling**	**1. Generic: try – except** 2. **try – except** (specific error type) 3. **try – except – else – finally**
3	**try – except – else – finally**	2 possible **workflows** based on condition **met** or failed in try block. 1: **try-except-finally** 2. **try-else-finally**

H. Threads & Process

	Features	Multi-Threading	Multi-Processing
2	Import **Library**	from **threading** import **Thread**	from **multiprocessing** import **Process**
3	1. **Define** (Target function)	def **targetFunction**(**arg**): <some code> **lst**=[] | for **x** in range(N): # N or use data iterable **lst.append(Thread(target=doSomething,args=(x+1,)))**	def **targetFunction**(**arg**): <some code> **lst=[]** | for **x** in range(N): # N or use data iterable **lst.append(Process(target=doSomething,args=(x+1,)))**
4	2. **Start**	for idx in range(len(**lst**)): **lst**[idx].**start()**	for idx in range(len(**lst**)): **lst**[idx].**start()**
5	3. **Join**	for idx in range(len(**lst**)): **lst**[idx].**join()**	for idx in range(len(**lst**)): **lst**[idx].**join()**
6	**PoolExecutor** (**concurrent.futures**)	**with concurrent.futures.ThreadPoolExecutor() as tex:** **tex.map(doSomething,[x for x in data_iterable])**	**with concurrent.futures.ProcessPoolExecutor() as pex:** **pex.map(doSomething,[x for x in data_iterable])**

4. Special Utilities/Libraries

A. Collections

1	**Counter** (Dictionary)	It is a **Built-in Frequency Counter** (from Collections library), a **dictionary** that stores **element:frequency** as **key:value** when assigned any string/list/tuple. For ex. **Counter([1,2,3,2,-1,-2,-3])** returns **Counter({2: 2, 1: 1, 3: 1, -1: 1, -2: 1, -3: 1})**. A dictionary that can store elements as key & its appearance count as value.
2	**DefaultDict**	It is a **dictionary** declared with (default type: **list |set | dict |tuple**), so that any non-existing key with return an **empty datatype** as default value. Ex. d**=defaultdict(list);** d[12] >> **[]**
3	**Deque**	A **double-ended queue** used to add or remove elements from **both ends**. Deque methods are – 1. **insert**(index, element) 2.**append[left]** (right/left), 3.**pop[left]** (right/left), 4. **extend[left]** (right/left), 5.**reverse**, 5.**rotate** (**x**) – **Right to Left** rotation.
4	**NamedTuple**	Access tuple elements using **attribute name** instead of index. List of attributes are defined in sequence for the **named** tuple. **Student = namedtuple('Student', ['name', 'age', 'DOB']); nandu = Student('Nandini', '19', '2541997')** **print(f"{type(nandu)} | {nandu.name}") >>** type(nandu): <class '__main__.Student'> | Nandini

B. Itertools

1	**permutations**	1. **N length** permutation on iterable (arr) → **list(permutations(arr,length=N))** 2. All possible permutations (of any length) on iterable (arr) → this does not require length argument. **allPerms = [] *(\n)* for i in range(1, len(arr)+1): allPerms.extend([x for x in permutations (arr,i)])**
2	**combinations** and **combinations with replacement**	1. **N** length combinations on iterable (arr) → **list(combinations(arr,length=N))** 2. **Powerset**: All possible combinations (of any length) on iterable (**arr**) → this does not require length argument. allCombs = [] (\n) for i in range(1, len(arr)+1): **allCombs.extend(list(combinations(arr,i)))** 3. **N** length **combination with replacement** → **list(combinations_with_replacement (arr,length=N))**
3	**groupby**	It is **consecutive occurrence counter** that returns **(frequence, element)** tuple for the iterable being grouped by. For Example. num = "1**222**31**333344**2"; print(**[(len(list(g)),int(k)) for k,g in groupby(num)]**) >> [(1, 1), (**3, 2**), (1, 3), (1, 1), (**4, 3**), (**2, 4**), (1, 2)]
4	**product**	**product()** returns a "**sorted list**" - the **cartesian product** of input iterables. **list(product([1,2,3],[10,20,30],[100]))** >> *[(1, 10, 100), (1, 20, 100), (1, 30, 100), (2, 10, 100), (2, 20, 100), (2, 30, 100), (3, 10, 100), (3, 20, 100), (3, 30, 100)]*

C. functools, operator

1	**functools.reduce()**	**lst=[1,2,30,4,55,6,7,8,9]; print(reduce(lambda x,y: x+y, lst)) >> 122 # calculates sum of the iterable** **Max: reduce(lambda x,y: x if x>y else y, lst) >> 55 |Min: reduce(lambda x,y: x if x<y else y, lst) >> 1**
2	**reduce** with **operator**	lst = [1,2,30,4,55,6,7,8,9]; print(**reduce**(**operator.add**, **lst**)) >> **122**

D. Numpy

1	Import **Library**	import **numpy** as **np**
2	**Numpy array** (ndarray)	**nd = numpy.array(iterable, dtype***[=float]*) → same for **1|2|3|N-dimension** | **nd.ndim** returns **dimension** of **nd** *Note: default dtype or datatype value is **float** (So, if **dtype** argument not provided it will create float nd array)*
3	Accessing **elements**	For, 1D → **nd[**index**];** 2D → **nd[***row_index, column_index***];** 3D → **nd[***array_index, row_index, column_idx***]**
4	**Modify** dimension	1. **nd.shape=(**rows,cols**)** | 2. **nd.reshape(**rows,cols**)** | 3. **numpy.transpose(nd) |** 4. **nd.flatten()** Note: methods **transpose, reshape, flatten** does NOT modify **original array** but **shape** does.
5	Create **Predefined dimension** methods	1. nd=numpy.**zeros**((rows,cols), dtype) 2. nd=numpy.**ones**((rows,cols), dtype) → creats ndarray with **0s** | **1s** 3. nd=numpy.**identity**((**N**), dtype) → returns a **NxN square matrix** 4. nd=numpy.**eye**((**rows, cols, k**), dtype) → returns **2D matrix** with k=diagonal position **1s** and rest all as **0s**
6	**Concatenate** on **axis**	syntax: numpy.**concatenate**((**nd1,nd2**), **axis**=**0|1|n**) → performs addition of 2 ndarray elements as per axis given.
7	**Math & Statistical** operations	A. **nd/2** or np.**divide**(nd, 2) | B. **nd1** (+ - * / ** %) **nd2** → np.**add|substract|multiply|divide|power|mod**(nd1,nd2) C. np.**floor|ceil|rint**(nd) | D. np.**sum|prod|min|max|mean|var|std**(**nd**, **axis**=**0|1|None**)
8	**Vector** operations	**l1, l2 = [1,2] , [3,4]** ; **A** = **np.array(l1)** ; **B** = **np.array(l2)** 1. **Dot** product: **np.dot(A,B)** | 2. **Cross** product: np.**cross**(A,B) | 3. **Inner** → np.**inner**(A,B) | 4.**Outer** → np.**outer**(A,B)

E. Regular Expression (re)

1	**Regex Methods**	1. re.**search(**exp,txt**)** returns a **re.Match** object with method/props like, **start(), end(), span(), string, group|s()** 2a. re.**match**(exp,txt) returns match object if pattern found **anywhere in the input text**. 2b. re.**fullmatch**(exp,txt) returns match object only if the text fully matches the pattern else return **None**. 3. re.**findall**(exp,txt) → **list** of all matching result. 4. re.**sub**(old chars**,** new chars**,** txt**,** occurrence) – replaces old text with new text as per occurrence (default = all). 5. re.**split**(delimiter, txt, max_occurrence) → returns a list of strings after the spilt by specified delimiter.
2	**Meta Characters**	1. **[]** →Set of chars **[acf]**, 2. **** →Escape special chars **\d \s**, 3. **|** →either or **s|d**, 4. **^**→ Starts with, 5. **$** →Ends with 6. **()** →Capture group, 7 **.** →any char, 8|9|10. ***(0 or more) **?**(0 or 1) **+**(1 or more) occurrences, 11. **{**min,max**}** → exact
3	**Special sequences**	These returns a **match** where found. **\d** (numbers 0-9) **\s** (space) **\w** (a-z,0-9,_) **\A** or **\Z** (chars starts or ends with) Returns **match** for the **opposite** cases. **\D** (not digits) **\S** (not space) **\W** (not a-z0-9_) **\B** (chars not at start or end)
4	**Sets**	1. Specified chars **[arn]** or **[012]** 2. In Range **[a-z]** or **[0-9]** 3. Not in **[^**exp**]** 4. **[0-5][0-9]** number between 00 to 59
5	Regex **group()**	It returns one or more subgroups of the match.
6	Look(**ahead|behind**)	A. Positive **lookahead**: **(?=<lookahead_regex>)** B. Positive **lookbehind**: **(?<=<lookbehind_regex>)**
7	Regex **flags** argument	**flags** argument is used to modify search behaviour: flags = re.**IGNORECASE** (Case Insensitivity) | re.**DOTALL** (Dot Matching Newline \n) | re.**MULTILINE (**Multiline Mode**)** | Verbose Mode| Debug Mode

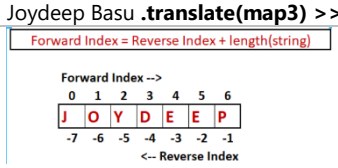
F. HTML/XML Parsers

1	**html parsing using** HTMLParser **library**	1. Import lib: from **html.parser** import **HTMLParser ;** 2. Create a custom class**:** myhtmlParser(HTMLParser)**,** 2. Override methods: **handle_(**starttag**|**endtag**|**startendtag**|**comment**|**data**|..)** using arguments**:** tag, attrs, data 3. Create parser object: chp = **myHtmlParser();** 4. Feed html-string**:** chp.**feed**(html_str)**;** 5. Close parser: chp.**close()**
2	**XML parsing** using xml2dict&ElementTree	Lib 1. import **xml2dict**; print(**xml2dict.parse(xml_string)** Lib 2. import **xml.etree.ElementTree** as **etree ;** tree = etree.**ElementTree**(etree.**fromstring**(**xml_string**)) ; root=tree.**getroot**() ; print(**root.attrib**) → Now, loop recursively for child nodes ie. for **child** in **root**: print(child.**attrib**)

5. Key Notes

SL	Category	Note
1	General	print(dir(**builtins**)) # prints a list of all python reserved built-in variables/names
2	Variables	Variable scope: The "**LEGB**" rule --> Local, Enclosing, Global, Built-in (order of overriding).
3	General	We can modify the **default delimiter (\n)** between 2 **print** statements using **end** parameter.
4	function (built-in)	**exit()** terminates the **whole program execution** irrespective of whether called in main() or any sub functions().
5	map + datatype funcs	To use data type specific functions with map, use **datatype.function** name inside **map**. Ex. map(**str.upper**,iterator)
6	global statement	use **global keyword** before variable name inside the local function to refer to the global instance of the variable.
7	break vs continue	break **exits the current loop** and continue **skips remaining steps** of current iteration & proceeds to next iteration.
8	switch case	Introduced in python **3.10 onwards** but not supported in earlier versions.
9	exit() or sys.exit()	Stops the entire execution wherever called - using **sys.exit()** or built-in function **exit()**.
10	String literals (**f** | **r** | **u**)	**f-literal** prints embedded **{expression}** along with string. **r-literal** prints raw string (including backslash) used for regular expression. **u-literal** is used for Unicode chars.
11	String split() delimiters	**split()** by default splits substrings **separated by one or 'more' spaces**. **split("")** throws empty delimiter exception.
12	String element search	If substring or element is missing, <str>.**find**(e) returns **-1** but <str>.**index**(e) throws **exception**, so **avoid index()**.
13	String partition vs split	string [r]**partition(delimiter)** always splits input into **3 parts** – 1. Before part, 2. delimiter, 3. After part, even if delimiter found in after part – it ignores which is not the case for split().
14	Slicing Rule	**1. Forward Index** = **Reverse Index** + **length** of Iterable. 2. Slicing happens **before End** index. Ex. lst**[0:3]**>**0,1,2**
15	Single element Tuple	**tup1 = (1,) Must use comma** if only **one value** is present else will be considered as other data type.
16	Message Formatting	1. Using **f-string** print(f"msg{exp}"), 2. Message with {placeholders}.**format**(named **argument | tuple | Dictionary**)
17	Round vs Format	For decimal place formatting - **round()** does NOT give correct results always, but **format()** does.
18	List index exception	If element not present **lst.index(ele)** returns exception, to avoid error use prefix: **if ele in lst** first
19	List copy from another	lst2=lst1 **copies the name only** without creating a new list, so any change in **lst2** with update the original list (**lst1**) To create an **independent** copy without affecting the original, use either A. lst2 = **lst1.copy()** or B. lst2 = **list(lst1)**
20	Iterable–create a **copy**	Use type conversion function on the original one i.e. **list(), tuple(), set(), dict()** creates a **new** copy of the original.
21	Use of **Asterix (*)**	1. Elements **unpacking** (***iterable**), 2. To pass **arbitrary/unknown** no of arguments (***args**), 3. To pass arbitrary/unknown number of **keyword arguments** (****kwargs**), 4. Calculate **Multiply** (*), 5. Calculate **Power** (**)
22	Multi-variable assignment at once	Use tuple to assign multiple variables at once. Ex. **var1, var2, var3 = tup** (here, **tup** must contains **3 values** only) If **tup** contains more than 3 values, write var1, var2, ***var3** = tup (to assign all rest from 3rd onwards as **list** for var3)
23	Iterable conversion & operation together	**tup=(1,2,3,); tup=list(tup).insert(0,0)** → will throw error but **l=list(tup); l.insert(0,0); tup=tuple(l)** will work fine. Iterable conversion & operation on it **at the same time fails**. Hence, perform them in separate lines.
24	Set operation representation and important notes	Set operations exactly follows to **Venn-diagram** of two or more circles. 1. **Union/Intersection/Symmetric difference** are **NON-Directional** i.e. returns **same result** for A on B or B on A. 2. Difference method is **directional** i.e. **(A-B)** and **(B-A)** returns **different results**. 3. **Symmetric difference** = **Union – Intersection**. 4. Set operations for **more than 2 sets** are possible. **set1**.union(**set2,set3,set4); set1**.intersection**(set2,set3,set4)** 5. Two sets are **disjoint** when they have **no common elements** so their intersection returns null.
25	Set **remove()** vs **discard()** vs **pop()**	Set's **pop()** removes any **random element** from set, it takes no argument. But remove/discard uses specific name. **remove(ele)** method throws **exception** if **element is not found** within the set but **discard(ele)** returns **None**.
26	Sort Dictionary by Key and Value	Sorted by **Key**: **{k:v for k,v in sorted(d1.items(),key=lambda x: x[0])}** Sorted by **value**: **{k:v for k,v in sorted(d1.items(),key=lambda x: x[1])}**
27	**Counter** use cases	Use Counters when calculations are related to **element frequency count** like – alphanumeric | word | line count.
28	**Default Dictionary** use cases	Use **defaultdictionary** in place of normal dictionary when one dictionary key may contain multiple **values** that needs to be stored in some iterable/list. Useful for **nested iterables**.
29	**Deque** uses case	**Array rotation** cases or both end element operations.
30	**hash()** note	**hash()** works in **immutable** objects and **returns exception** when used on **mutable** objects. A. **Immutable**: **hash((1, 2, 3,-4))** | **hash("Joydeep")** → valid. B. **Mutable**: **hash([1,2,3,4,5,6,7,8])** throws exception
31	**map()** vs **reduce()**	Both **map & reduce** works on iterable **elements** but reduce **reduces the iterator** to a **single return value** by comparing among elements **consecutively** while map runs for **every element** & returns an **iterator object**.
32	**Class** notes	1. **Class Namespace** - **ClassName.__dict__** will show all class attributes/methods like a **dict key:pair** 2. **Class attributes** are COMMON to all i.e. object/instance independent. 3. **Instance attributes** are initiated inside class Constructor (__init__) and requires self keyword to access them. 4. **self keyword** is **mandatory** in all instance methods of a class as the first argument. 5. **super().__init__()** - Used within **child class constructor to instantiate parent class constructor** with matching arguments provided in the child class constructor. It does NOT require any 'self' keyword as first argument. 6. **isinstance(object, class)** - return **True/False**, checks if the variable/object is an **instance** of the specific **class** or not. If object created from child class, it returns true for both **super class** as well as **child class**. 7. **__repr__()** defines the **string representation** of a class. There are some **dunder** methods.
33	**Oops** notes	1. Python does not support **method overloading** what java does.
34	Decorator **Chaining**	When multiple decorators are used on a function it is called decorator chaining.
35	**Closure** notes	It is a **nested function**. The closure will have **access to a 'free' variable** that is in outer scope. It will be returned from the **enclosing (outer) function**. Closure can be called a **function object** (function as **object**) that is capable of **remembering values** that are in **enclosing scopes** (outer functions) even if they are not present in memory.
36	Multi-**Thread|Process**	1. **Multithreading** are good for **I/O bound tasks** where as **Multiprocessing** are good for **CPU-bound tasks**. 2. **Multi-threading** adds **some overhead** but **multi-processing** does NOT and therefore **truly concurrent**.
37	Thread/Process **join()**	join() **pauses code execution** until **completion** of thread/process else it will **proceed** to **end** or **next code block**.
38	**Pool Executor**	concurrent.futures.(Thread|Process)**PoolExecutor**() → **Context manager** that automatically handles **joining**.
39	**Date/Time** libraries **Timezone** operation	import **datetime** as **dt** | from **dateutil** import **tz** **fmt**='%a %d %b %Y %H:%M:%S %z'; **dt1** or **dt2** = **dt.datetime.strptime**(date1|date2,fmt).**astimezone**(**tz.tzlocal()**) **diff** = **dt1 - dt2** if **dt1 > dt2** else **dt2 - dt1** ; to calculate difference in seconds → **diff.total_seconds()**
40	Set element **update**	set1**.discard(old_element)**; set1**.add(new_element)**

6. General Examples

#	Topic / Context	Example
1	**Scope** of variables - **LEGB rule**	x = 'global x' **def outer():** # **global x** # if enabled, this will update the global variable (x) value from 'global x' --> to 'local x' x = 'local x' **def inner():** # **nonlocal x** # if enabled, this will update the local variable (x) value from 'local x' -> to 'enclosing x' x = 'enclosing x' print(x) inner() # prints the 'enclosing x' (enclosing scope) when nonlocal x is NOT used print(x) # prints the 'global x' (global scope) when global x is NOT used inside outer function
2	String **stripping** unwanted characters	' Joydeep Basu '**.strip()** > **Joydeep Basu** | '$$$Joydeep$$$Basu###'**.strip('$')** >> **Joydeep$$$Basu###** '$$$Joy$$$Basu##'.**lstrip('$')** > **Joy$$$Basu##** | '$$Joy$$$Basu###'**.rstrip('#')** >> **$$Joy$$$Basu** '$$$Joydeep$$$Basu########'**.lstrip('$').rstrip('#').replace('$$$',' ')** >> **Joydeep Basu**
3	String **filling** (justifying text)	Joydeep Basu .**center(50,'-')** >> **----------Joydeep Basu----------** Joydeep Basu .**ljust(50,'-')** >> **Joydeep Basu----------** Joydeep Basu .**rjust(50,'-')** >> **----------Joydeep Basu** Joydeep Basu .**zfill(50)** >> **00000000000000000000000000000000Joydeep Basu**
4	String **Replacing** characters	#####Joydeep**Basu###### **.replace('#','')** >> **Joydeep**Basu** #####Joydeep**Basu###### **.replace('*','',1)** >> **#####Joydeep*Basu######** #####Joydeep**Basu###### **.replace('#','').replace('*','',1).replace('*',' ')** >> **Joydeep Basu**
5	String **Expand Tabs** function	J O Y D E E P .**expandtabs(0)** >> **JOYDEEP** J O Y D E E P .**expandtabs(2)** >> **J O Y D E E P** J O Y D E E P .**expandtabs(4)** >> **J O Y D E E P**
6	String **Translate** & **Make translation** function (encoding)	**str.maketrans('e','i')** > (map1) > {101: 105} | Joydeep Basu .**translate(map1) Joydiip Basu** str.**maketrans**('JB','jb') > (map2) > {74: 106, 66: 98} | Joydeep Basu **.translate(map2) joydeep basu** str.**maketrans**('JBe ','jbi*', **'ou'**) > (map3) > {74: 106, 66: 98, 101: 105, 32: 42, **111: None**, **117: None**} Joydeep Basu **.translate(map3) >> jydiip*bas**
7	Iterable **Slicing** rules	 name**[0]** or name**[-7]** >> **J** |name**[6]** or name**[-1]** >> **p** name**[:]** or name**[0:7]** = **Joydeep** | name**[-7:0]** >> (null) name**[:3]** or name**[:-4]** = **Joy** | name**[3:]** or name**[-4:]** >> **deep** name**[3:5]** or name**[-4:-2]** = **de** (End index element not counted) name**[::-1]**=**peedyoJ** (reversed) |name**[::2]** = **Jyep** | name**[1::2]** = **ode**
8	Print message formatting using **tuple, dictionary** & **named arguments** with **format()**	**valTuple1** = ('Joydeep','39'); **valDict1** = {'name':'Jui','age':18} print('Hi, I am **{}**, and my age is a variable, as of now, **{}** years.\n' 'And **{name}** is my wife and her age is a constant, always **{age}** years.'.**format(*valTuple1, **valDict1)**) print('My name **{name}** and age is **{age}** years.'.**format(name='Joydeep',age=39)**)
9	Logical operators (**and, or, not**) within if (**in range, is None**)	**x:10, y:3** | x if x>y else y >> **10** True if **(x>=10 and y<=5)** else False >> **True** | True if **(x>=10 or y<=5)** else False >> **True** True if not **(x>=10 and y<=5)** else False >> **False** | True if **not (x is None or y is None)** else False >> **True** True if (**x in [5,10,15] and y not in [1,2,3]**) else False >> **False** True if (**x in range(11) and y not in range(3)**) else False >> **True**
10	Element Unpacking (***iterables**)	if lst=[1,2,3,4,5,6,7,8] then, **' '.join(map(str,lst))** is same as print(***lst**) → space separated string elements.
11	Function (***args**)	def func1(***args**): return sum(args) | print(f"**Unknown no. of arguments** sum: {**func1(10,20,30,40)**}") >> **100**
12	Function (****kwargs**)	def func2(****kwargs**): for key in **kwargs**: print(f"Value of [{**key**}] is:{**kwargs[key]**}") func2(**fname="Joy"**,**lname="Basu"**,**age=39**) >> Value of [**fname**] is:**Joy** Value of [**lname**] is:**Basu** Value of [**age**] is:**39**
13	Generate 2D numpy matrix (0s)	numpy.matrix(**[[0 for x in range(10)] for y in range(10)]** or (**[[0]*10]*10**)) >> numpy matrix (list of lists).
14	Generate a Panda Dataframe	pd.**DataFrame**(**[{'param1':'val1','param2':'val2','param3':'val3'} for y in range(10)]**) >> (list of dicts)
15	Dictionary of lists Nested Dictionary	1. **Dictionary of Lists**: {y:[] for y in range(10)}; 2. **Nested dictionary**: nestedDict = {y: {'param1': 'val1', 'param2': 'val2', 'param3': 'val3'} for y in range(10)}
16	List **extend()** vs **append()**	d1, rExt, rApp = {1: [10,20], 2: [4,11], 3:[0,20]}, [], [] for x in d1.values():**rExt.extend(x)** >> [10, 20, 4, 11, 0, 20] → extend **adds the elements** of a new list. for x in d1.values():**rApp.append(x)** >> [[10, 20], [4, 11], [0, 20]] → append **adds the new list** itself.
17	String/Tuple/List/Set to Dictionary using **enumerate()**	txt = 'Joy deep Basu'; lst = ['Joy', 'Deep', 'Basu']; tup = ('Joy', 'Deep', 'Basu'); set1 = {'A','E','I','O','U'} **print({k:v for k,v in enumerate(txt|lst|tup|set1, 0)})** # **string|list|tuple|set** to **dictionary**
18	**For Else** loop	For **N=3** → the **else print** statement will NOT be executed (**since loop is breaking**) but for **N=7** it will. **for x in range(5):** if x>=**N**: **break;** print(f"Current value: {x} is less than break condition {**N**}") **else:** print(f"Current loop did not reach break condition, so else block is executed")
19	**break** vs **continue**	i, lst = 0, [] while **i <=10**: if **i == 5: break** # Keyword break **exits the loop at 5**, so 6,7,8,9,10 not executed. i+=1 if **i == 3: continue** # this skips next 'append' step & proceed to next iteration → **3** not appended to **lst** lst.append(i) **print(lst)** >> **[1, 2, 4, 5]**

20	**match..case** (supported in python version **3.10** onwards)	**match exp**: **case 0**: return "zero" \n **case 1**: return "one" \n **case 2**: return "two" \n **case default**: return "something"
21	**reversed()**	txt = 'Joydeep'; tup = (1,2,3); lst = [1,2,3]; list(reversed(txt)) → ['p', 'e', 'e', 'd', 'y', 'o', 'J'] | list(reversed(lst)) → **[3, 2, 1]** | print(list(reversed(tup)))>**[3, 2, 1]**
22	Use of '**end**' in print statement default value of **end** is '**\n**')	lst1 = [1,2,3,4,5,6,7,8,9] >> for x in lst1: print(x, **end**='') lst2 = ['My','age','is','40'] >> for x in lst2: print(x, **end**='$') → **123456789** **My$ageis40$**
23	Print() > **sep** param	**print(1,2,3,4,sep='-')** >> **1-2-3-4** → default value of sep parameter is ''
24	Input() - **default message**	ans = **input('What is your name? ')**; print(ans) → input() is prompting a **default msg.** first before printing user provided input.
25	debugging using **pdb**	**import pdb** | a = 19; b = 0 | **pdb.set_trace()** | addition = a+b | substraction = a-b | **pdb.set_trace() | ...** Common PDB commands, # 1. **l** (list, shows all lines and show the debugging cursor (line number) where execution is paused) # 2. **n** (next, executes current line, and moves to next line) # 3. **p** (print, print variable values to check manually) # 4. **c** (continue, executes all the remaining commands until end or a new pdb.set_trace() line found.)
26	**Function** as **Decorator**	def **decorator_func**(**func**): print("prerequisites"); **return func** # **decorator function** must **return** the original function **@decorator_func** # Here, @decorator function name is passed def **orginal_function**(): print("main") **orginal_function()** >> **prerequisites \n main** # original function **first executes decorator function**
27	**Class** as **Decorator**	**class deco**: # class decorator that prints the called function result **def __init__(self,func)**: **self.func = func** **def __call__(self, *args, **kwargs):** # wrapper function that executes the orginal function **print(f"class decorator code: {self.func.__name__,*args}")** # Extra code on top of original function **print(f"Output: {self.func(*args, **kwargs)}")** # executes the original function **@deco** **def add(x,y): return x+y** >> **class decorator code before executing: ('add', 10, 20) \n Output: 30**
28	**Decorator** with **Arguments**	**def p(func)**: # decorator function that prints the called function result **def wrapper(*args, **kwargs**): # wrapper function that executes the orginal function **print(f"wrapper code to modify:{func.__name__, *args}")** # Extra code on top of original function **print(f"Output: {func(*args, **kwargs)}")** # executes the original function **return wrapper** # returns the original function after decoration/wrapper codes **@p** **def add(x,y): return x+y** >> **wrapper code to modify:('add', 10, 20) \n Output: 30**
29	regex **search()** vs **match()** vs **fullmatch()**	**search() & match()** return match for **partial string match** but **fullmatch()** requires **whole string match**. re.**search("^x", 'x123sd432df'))** returns **<re.Match object; span=(0, 1), match='x'>** re.**match("^x", 'x123sd432df'**)) returns **<re.Match object; span=(0, 1), match='x'>** re.**fullmatch("^x", 'x123sd432df'**) returns **None** but, re.**fullmatch**("**^x\w***",'**x123sd432df**') returns <re.Match object; span=(0, 11), match='x123sd432df'>
30	re **split()** subtext extraction	txt='**x123sd432df**' ; exp="**[0-9]+**" ; print(re.**split**(exp,txt)) >> **['x', 'sd', 'df']** #extract text between numbers
31	re **findall()** numbers extraction	txt='**x123sd432df**' ; exp="**[0-9]+**" ; print(re.**findall**(exp,txt)) >> **['123', '432']** #extract numbers in whole text
32	re **sub()** replace & extract text or numbers	txt='**x123sd432df**' ; old="**[0-9]+**" ; new="" print(re.**sub**(old, new, txt)) >> **xsddf** txt='**x123sd432df**' ; old="**[a-z]+**" ; new="" print(re.**sub**(old, new, txt)) >> **123432**
33	**Extraction** of digits-letters alphanumerals & special chars from given text	txt=' -_!||{}^:;/\<>*PO Number generated 13982020 successfully****()^!@#$%%_&' 1. **Numbers**: re.**sub**("**[^0-9]**",'', txt) >> **13982020** 2. **Letters**: re.**sub**("**[^a-zA-Z]**",'', txt) >> **PONumbergeneratedsuccessfully** 3. **Spl chars**: re.**sub**("**[a-zA-Z0-9]**",'', txt) >> **`-_!\|\|{}^:;/\<>* ****()^!@#$%%_&** 4. **AlphaNumerals**: re.**sub**("**[^a-zA-Z0-9]**",'', txt) >> **PONumbergenerated13982020successfully**
34	re match **groups()**	**txt =** '**username@hackerrank.com**' ; **exp**= r'**(\w+)@(\w+)\.(\w+)**' ; **m**=re.**match**(exp,txt); print(**m.groups()**) #>> **('username', 'hackerrank', 'com)** print(**m.group(0)**) #>> **'username@hackerrank.com'** (The entire match) print(**m.group(1)**) #>> **'username'** (The first parenthesized subgroup) print(**m.group(2)**) #>> **'hackerrank'** (The second parenthesized subgroup) print(**m.group(3)**) #>> **'com'** >> (The third parenthesized subgroup) print(re.**findall**(exp, txt)) #>> **[('username', 'hackerrank', 'com')]** (a **list of group tuple**)
35	re match **groupdict()** with named parameter	**re.match(r'(?P<user>\w+)@(?P<domain>\w+)\.(?P<ext>\w+)','jbasu@hackerrank.com').groupdict()** >> {'user': 'jbasu', 'domain': 'hackerrank', 'ext': 'com'}
36	re flags=re.DOTALL **multi-line extraction**	txt = """ Extract below code, ``` # delimiter ``` starts here, to be used in reg expression **x = 10; y = 20** **print(x+y)** ``` # delimiter ends here. **re.DOTALL** enforces **Multi-line search** including (\n). That's all! """ print(re.**findall**("```(.*)```", txt, **flags=re.DOTALL**)) >> **['\nx = 10\ny = 20\nprint(x+y)\n']**
37	re **Number range** validation	print**(bool(re.match(r'[1-9][0-9]{5}$', num)))** >> validates '**num**' between **100000** - **999999**
38	re.**findall** - Positive **lookahead**	**Alternative repetitive numbers** find: print(re.**findall**(r'**(\d)(?=\d\1)**', "13**7**1**7**9**1**9")) >> **['7', '9']** Here, **\d** → Match and capture a digit in group | **(?=** →Start lookahead | **\d** → Match any digit **\1**: **Back-reference** to **captured group** for searching for **same digit** | **)** → End lookahead

7. Special Ops

#	Special Operations	Example	Result/Note
1	HTML element attributes extraction (key:value)	html_str = ' a **src**="http www example.com" **alt**="beautiful mountain" **href**="http://example.com" ' print(re.**findall**("**\s(.*?)=[\"|\'](.*?)[\"|\']**", **html.strip()**)) returns, **[('src', 'http www example.com'), ('alt', 'beautiful mountain'), ('href', 'http://example.com')]**	
2	**eval() & exec()** on **string formatted exp** (dynamic code)	lst=[1,2,3]; **eval("print([x**2 for x in "+str(lst)+"])") >> [1, 4, 9]** **exec("print([x**2 for x in "+str(lst)+"])") >> [1, 4, 9]**	
3	Use of **Zip()** on multiple iterables	A = **[1,2,3,'c']**; B = **[6,5,4,10,11,12,13,14,15]**; C = **[7]**; print(**list(zip(A,B,C))**) >> **[(1, 6, 7)]** t1 = "Joydeep"; t2 = "Basu"; print(**list(zip(t1,t2))**) >> **[('J', 'B'), ('o', 'a'), ('y', 's'), ('d', 'u')]**	
4	Use of **exit()** > Stop execution	p = print; p("Hello, world!") **exit()** p("Bye bye!")	**Hello, world** *[note: print(Bye bye!") is unreachable because code stops at exit()]*
5	**empty iterable** as looping/if-else condition	a = [] **while a:** print('Not empty') >> prints nothing	while condition is False as a is empty so loop never executes.
6	**Ternary** conditional operation	**print('kid' if age < 18 else 'adult')** print('kid' if age < 13 else 'teen' if age < 18 else 'adult')	**<exp1> if <condition> else <exp2>**
7	**Overlapping substring** frequency	string's **count**() method returns **Non-overlapping count** of substring but it **fails for overlapping** substring cases. To overcome this, Use a while **loop** until **ostr.find(sstr)** returns **-1** with original string **slicing[last_match_index+1:]**	If, String: **Banana** and Substring: **ana** **ostr.count(sstr) returns 1** (actual count 2). This can be achieved using below: **while ostr.find(sstr)>=0:** **cnt+=1; ostr=ostr[ostr.find(sstr)+1:]**
8	**Comprehension** without storing results	even, odd, nums = [],[], [1,2,3,4,5,6,7,8,9,44,45,46,47,48,49,100,101,102,103,104,105] **[odd.append(x) if x%2!=0 else even.append(x) for x in nums if x<100]** → *(this result list is not stored)*	
9	Print **all built-ins**	**print(dir(builtins))**	**import builtins** (required to import first)
10	Print all **local scope names**	def func1(): **a=10; s1={1,2,3,5};**	For this function, **print(dir())** >> **['a','s1']**
11	Print all **global & local** scope runtime parameters	a,b,c=10,[0,1,2,3,4,5], {1:'Joy', 2:'Deep', 3:'Basu'} print(**globals()**) # **globals()** returns the **dictionary** implementing the **current module namespace**. print(**locals()**) # **locals()** returns a **dictionary** with the **current local symbol table**.	
12	Debugging - use of **breakpoint()**	a = {1:'Joy', 2:[]} ; txt = 'History' **breakpoint()** a[2]=txt; print(a)	Here, **breakpoint() pauses** the execution and enters into debugging mode. Remaining code waits until quit debugging mode.
13	Text message **encoding**	def encode(txt): return print(**bytes**(txt, **encoding='utf-8'**))	Note: use **bytearray** for array of bytes.
14	List element **swapping**	arr = ['Joy','Deep','Basu']; **arr[0], arr[1]** = **arr[1],arr[0]**	
15	Element position (**index**) vs Iterable **index**	lst=[1,2,30,40,90,80,**3**]; print(**lst.index(3),' vs ', lst[3]**) returns **6 vs 40** **lst.index(ele)** returns the **ele** position (index) within lst, whereas, **lst[idx]** returns ele value at idx position.	
16	List item **insertion** using **slicing**	**lst[0:0]=[0]** → (**beginning**) Using **slicing** with same position **index** as **start:end** = **[**item**].** **lst[idx:idx] = [50]** → (anywhere in the **middle**) **lst[len(lst):len(lst)]**=[10] → (at the **end**) Note: in all cases new element must be **wrapped** with **[]**.	
17	**Reverse** a Dictionary (value:key) (Note: values can be duplicate so keys with same value must be stored in a list.	res={} for key in dct.key(): if key not in res: res[key]=[] res[key].append(dct[key])	
18	**Nested Iterable value sorting** (list/tuple of tuple/list, dict of lists) → by value index (idx)	tup=[(1,3,5),(3,2,1),(1,1,1),(5,6,7)] |arr=[[1,3,5],[3,2,1],[1,1,1],[5,6,7]] |dct={1:[1,3,5],2:[3,2,1],3:[1,1,1],4:[5,6,7]} 1. **List of Tuples** sorting by **2nd** value (**idx=1**) → **[x for x in sorted(tup, key = lambda x: x[idx])]** 2. **List of Lists** sorting by **2nd** value (**idx=1**) → **[x for x in sorted(arr, key = lambda x: x[idx])]** 3. **Dict of Lists** sorting by **2nd** value (**idx=1**)>**{k:v for k,v in sorted(dct.items(), key=lambda x: x[1][idx])}**	
19	Collections > **Counter**	**Counter** on string/list/tuple returns, **Counter('Joy Deep ')** >> **Counter({' ': 2, 'e': 2, 'J': 1, 'o': 1, 'y': 1, 'D': 1, 'p': 1})** **Counter([1,2,3,2,-1,-2,-3])** >> **Counter({2: 2, 1: 1, 3: 1, -1: 1, -2: 1, -3: 1})** **Counter((1,2,3,2,-1,-2,-3))** >> **Counter({2: 2, 1: 1, 3: 1, -1: 1, -2: 1, -3: 1})**	
20	Collections> **DefaultDictionary**	d = **defaultdict(list)**; print(**d[100]**) >> [] # Key 100 is not yet assigned so, default value [] returned. for i in range(1,5): d[i].append(i**2); print(d)>**defaultdict(<class 'list'>, {100: [],1: [1],2: [4],3:[9], 4: [16]})**	
21	Collections > **namedtuple**	**Point = namedtuple('Point', ['x', 'y']); pt = Point(1, 2);** print(**pt.x**, **pt.y**) >> **1 2**	
22	Itertools> **groupby**	txt = "Joyd**ee**p"; lst = [1,2,3,4,**5,5,5**,6,7,8,9,10]; tup = (1,2,3,**4,4**,3,**5,5,5**,6) **[(len(list(g)),k) for k,g in groupby(txt)]** >> [(1, 'J'), (1, 'o'), (1, 'y'), (1, 'd'), (2, 'e'), (1, 'p')] **[(len(list(g)),k) for k,g in groupby(lst)]** >>[(1, 1), (1, 2), (1, 3), (1, 4), **(3, 5),** (1, 6), (1, 7), (1, 8), (1, 9), (1, 10)] **[(len(list(g)),k) for k,g in groupby(tup)]** >> [(1, 1), (1, 2), (1, 3), **(2, 4),** (1, 3), **(3, 5),** (1, 6)]	
23	Itertools > **product**	**list(product(['a','b','c'],repeat=2))** >> *[('a','a'), ('a','b'), ('a','c'), ('b','a'), ('b','b'), ('b','c'), ('c','a'), ('c','b'), ('c','c')]* **list(product([1, 2, 3],repeat=2)) >>** *[(1, 1), (1, 2), (1, 3), (2, 1), (2, 2), (2, 3), (3, 1), (3, 2), (3, 3)]*	
24	Itertools > **Permutations**	**1. N**-length permutation → **list(permutations([1,2,3],2)) >>** [(1, 2), (1, 3), (2, 1), (2, 3), (3, 1), (3, 2)] **2. All possible** permutations**:** [(1,), (2,), (3,), (1, 2), (1, 3), (2, 1), (2, 3), (3, 1), (3, 2), (1, 2, 3), (1, 3, 2), (2, 1, 3), (2, 3, 1), (3, 1, 2), (3, 2, 1)]	
25	Itertools > **Combinations**(comb) **& combinations with replacement** (cwr)	1. **N-length** combinations: **list(combinations([1,2,3],2))** >> *[(1, 2), (1, 3), (2, 3)]* 2. **All possible** combinations (Powerset): **ps = [] ; for i in range(1, len(arr)+1): ps.extend(list(combinations(arr,i)))** >> *[(1,), (2,), (3,), (1, 2), (1, 3), (2, 3), (1, 2, 3)]* 3. **N-length** combination with replacement: **list(combinations_with_replacement([1,2,3],2))** >> *[(1, 1), (1, 2), (1, 3), (2, 2), (2, 3), (3, 3)]*	