

CS 146 Fall 2025 – Final “Cheat Sheet”

Numeric Operators

+, -, /, *, **: Addition, subtraction, true division, multiplication, power

//: Floor division: Round division result down to nearest whole number

%: Modulo: Evaluate to remainder of division

Comparison Operators

==, !=: Equals, not equals

>, >=, <, <=: Greater than, greater than or equals, less than, less than or equals

Boolean Operators

not op, op1 and op2, op1 or op2: Logical NOT of op, AND of op1 and op2, OR of op1 and op2

Indexing Operator

seq[idx]: Item of seq at index idx

seq[start:stop[:step]]: Copy of subsequence of seq from inclusive start to exclusive stop by step

seq[:]: Copy all items in seq

Precedence:

parentheses > indexing > ** > negate > *,/,//,% > +,- > comparisons > not > and > or

Range

range(stop): Equivalent to range(0, stop, 1)

range(start, stop[, step]): Create sequence of integers from inclusive **start** to exclusive **stop** by **step**

Input/Output

- Reading input from the user
input(message): Displays message to the user and returns what the user typed as a string
- Reading from a file with a for loop
with open(filename, "r") as file:
 for line in file:
 # do something with line (a string)
- Writing to a file
open(filename, "w"): Write to file (overwrite any existing content)
open(filename, "a"): Append to the end of existing contents
file.write(item): Writes item to file (e.g. string, number) w/o trailing newline

Command Line Arguments

- Access command line arguments when file is run as a program
import sys
__name__ is automatically set to "__main__" when file is run
if __name__ == "__main__":
 # For python program.py arg1 arg2, sys.argv is ["program.py", "arg1", "arg2"]

Built-in functions

abs(a): Return absolute value of number a

Strings

- The following functions are built-in
len(string): Returns the number of characters in the string
int(string), float(string), str(object): Converts numeric string to int or float, or object to a string
sorted(string): Returns the characters of the string as a list in sorted order

- String object methods
 - count(some_string):** Return number of occurrences of **some_string** in the string
 - index(some_string):** Returns the index of the first occurrence of **some_string** or error if it does not occur
 - upper(), lower(), capitalize():** Returns a new upper or lower-cased, or 1st letter upper-cased string
 - find(some_string):** Returns the first index that **some_string** occurs at in the string or -1 if not found
 - find(some_string, index):** Same as above, but starts searching at index
 - replace(old, new):** Return a copy of the string with all occurrences of old substituted with new
 - startswith(prefix):** Returns **True** if the string starts with prefix, False otherwise
 - endswith(suffix):** Returns **True** if the string ends with suffix, False otherwise
 - strip():** Returns a copy of the string with only the leading and trailing whitespace removed
 - split():** Return a list of the words in the string using whitespace as the delimiter
 - isalpha():** Return **True** if all characters in string are alphabetical and the string has at least one character
 - isdigit():** Return **True** if all characters in string are numeric digits and the string has at least one character
- String operators
 - string1 + string2:** Returns a new string that is the concatenation of string1 and string2
 - string * int:** Returns a new string that is string repeated int times
 - substr in string:** Returns True if substr is a substring of string, False otherwise

Lists

- []** creates empty list
- [object1, object2, ...]** creates list containing objects
- list(iterable)** creates a list from any iterable object (e.g., range, string)
- The following functions are built-in
 - len(list):** Returns the number of elements in list
 - sum(list), min(list), max(list):** Returns the sum, min, or max of elements in list
 - sorted(list):** Returns a new copy of the list in sorted order
- List object methods
 - count(item):** Returns the number of occurrence of item in the list
 - index(item):** Returns the index of the first occurrence of item in the list or error if it does not occur
 - append(x):** Adds x to the end of the list
 - extend(other_list):** Adds all elements of other_list to the end of the list
 - insert(index, x):** Insert x before index in the list
 - pop():** Removes the item at the end of the list and returns it
 - pop(index):** Removes item at index from the list and returns it
 - remove(value):** Remove first occurrence of value from list
 - reverse():** Reverses the elements in the list in place
 - sort():** Sorts the elements of the list in place, returns None
- List operators
 - list1 + list2:** Returns a new list that contains the elements of list1 followed by the elements of list2
 - list * int:** Returns a new list that contains the items in list repeated int times
 - item in list:** Returns True if item is an element of list, False otherwise

Sets

- set()** creates empty set
- {elt1, elt2, ...}** creates a new set with the given elements
- set(iterable)** creates a set from any iterable object (e.g., string, list)
- The following functions are built-in and answer questions about sets
 - len(set):** Returns the number of elements in the set
- Set object methods
 - add(elt):** Adds elt to the set

- clear():** Removes all elements from the set
- pop():** Removes an arbitrary element from the set and returns it
- remove(elt):** Removes **elt** from the set
- union(set2):** Returns new set with union of itself and set2
- update(set2):** Update itself with union of itself and set2
- Set operators
 - elt in set:** Returns True if **elt** is an element of set, False otherwise
 - set1 < set2:** Returns True if set1 is a proper subset of set2 (every element of set1 is in set2 and set1 != set2)
 - set1 | set2:** Returns union of the two sets (new set with elements from both set)
 - set1 & set2:** Returns intersection of the two sets (new set with only elements common to both sets)
 - set1 - set2:** Returns set difference (new set with elements set1 not in set2)
 - set1 ^ set2:** Returns set symmetric difference (new set with elements in set1 or set2 but not both)

Dictionaries

- {}** create empty dictionary
- {key1:value1, key2:value2, ...}** creates a new dictionary with key-value pairs
- The following functions are built-in and answer questions about dictionaries
 - len(dict):** Returns the number of entries (key-value pairs) in the dictionary
- Dictionary object methods
 - clear():** Removes all entries from the dictionary
 - keys():** Returns an iterable object of all the keys in the dictionary
 - values():** Returns an iterable object of all the values in the dictionary
 - items():** Returns an iterable object of all (key, value) tuples in the dictionary
 - get(key[, item]):** Returns value associated with **key** if in dictionary, **item** otherwise. **item** defaults to None.
- Dictionary operators
 - item in dict:** Returns True if **item** is in the keys of **dict**, False otherwise

Tuples

- Creating new tuples
 - ()** creates empty tuple
 - (object1, object2, ...)** creates tuple containing objects
- The following functions are built-in and answer questions about tuples
 - len(tuple):** Returns the number of elements in the tuple
- Tuple operators
 - item in tuple:** Returns True if **item** is contained in tuple, False otherwise
 - tuple1 + tuple2:** Returns a new tuple that is the concatenation of tuple1 and tuple2

Classes

- Define a class **DerivedClass** that inherits/derives from **BaseClass**

```
class DerivedClass(BaseClass):
    def __init__(self, x):
        # Initialize instance variables, e.g.
        self.x_coord = x

    def a_method(self, y):
        # ...
```
- Create an instance of a class: **DerivedClass(4)**
- **print** uses the **__str__** method
- Operators +, -, *, / map to methods **__add__**, **__sub__**, **__mul__**, **__truediv__**
- Operators ==, !=, <, <=, >, >= map to methods **__eq__**, **__ne__**, **__lt__**, **__le__**, **__gt__**, **__ge__**

Modules

- **turtle** module
 - forward(dist), backward(dist)**: Move the turtle forward/backward by the length `dist`. Doesn't change heading.
 - right(angle) left(angle)**: Turn the turtle right/left by `angle` (in degrees)
 - goto(x, y)**: Move turtle to position `x, y`
 - setheading(angle)**: Set the turtles heading to `angle`
 - circle(radius)**: Draw a circle with specified `radius`; the center is `radius` above the starting position
 - dot(size)**: Draw a filled circle with diameter `size` centered on current position of the turtle
 - penup(), pendown()**: Pick up (don't draw when moving) or put down (draw when moving) the pen
 - fillcolor(color)**: Change the fill color to `color`, where `color` is a string
 - begin_fill(), end_fill()**: Start and end filling shapes with fill color
- **random** module
 - randint(a, b)**: Return a random integer `N` such that $a \leq N \leq b$
 - uniform(a, b)**: Return a random floating point number `N` such that $a \leq N < b$
 - shuffle(lst)**: Shuffle list in place randomly and return `None`
 - choice(seq)**: Return random element from non-empty sequence
- **math** module
 - sqrt(num)**: Return the square root of `num`
- **numpy** module (**import numpy as np**)
 - np.array([10, 12, 14, 20])**: creates 1-D vector from list
 - a+b, a-b, a*b, a/b**: element-wise addition, subtraction, multiplication, true division on vectors
 - a>3**: element-wise comparison (returns boolean vector)
 - np.sqrt(a)**: compute element-wise sqrt
 - np.abs(a)**: compute element-wise absolute value
 - np.power(a, exp)**: raise `a` to the power `exp` element-wise
 - len(x)**: number of elements in a vector
 - np.sum(x), np.max(x), np.min(x), np.mean(x)**: return scalar sum, max, min, mean of vector
 - np.linspace(start, stop, num)**: create `num` evenly spaced numbers from `start` to `stop` (inclusive)
 - np.random.sample(num)**: returns an array of `num` random numbers where each number `N` is $0 \leq N < 1$
- **datascience** module (**import datascience as ds**)
 - ds.table().with_columns('a', [1,2], 'b', [3,4])**: Create table with columns `a` and `b`
 - t["b"], t["b"]:=**: Evaluate to column named `b` in table `t` as a vector, create/assign to column named `b`
 - t["b"].sum(), t["b"].max(), t["b"].min(), t["b"].mean()**: compute sum, max, min, mean of column `b` in table `t`. Equivalent to calling NumPy function on column vector, e.g., **np.sum(t["b"])**
 - t.with_column('b', [1,2])**: Return table `t` with new column named `b`
 - t.select(["a","b"])**: Evaluate to the subset of table `t` with just columns named `a` and `b`
 - t.sort("a")**: Return table with rows sorted in ascending order of values in column `a`
 - t.where(expr)**: Extract rows of table `t` for indices at which `expr` is True
 - t.group("a",[fn])**: Group `t` by unique values in columns `a` and apply `fn` to those groups independently to produce a new table. If not specified, `fn` defaults to counting rows in group.
- **matplotlib** module (**import matplotlib.pyplot as plt**)
 - plt.plot(x, y)**: add data in iterables `x` and `y` to the plot
 - plt.show()**: display the graph
 - plt.xlabel(string), plt.ylabel(string)**: label the x- or y-axis with `string`
 - plt.title(string)**: set `string` as the title of the plot