Lecture 19: Introduction to Computer Programming Course - CS1010

DEPARTMENT OF COMPUTER SCIENCE | 04/1/2019

Rensselaer

Announcements

- Exam 2 Grades are posted on Submitty:
  - Average is 63, Highest is 95.
  - You can request for re-grading in a weeks time (until 11:59 pm on April 8)
  - All regrading requests should come to me directly via email
  - Please do not pay attention to the files uploaded along with your grade
  - Those are for my reference (NOT necessarily what you wrote in the exam)

- Follow/Subscribe the following (On YouTube):
  - Datascience Concepts

Goals for today

- Introduction to Sets
- Sets in Python

Sets

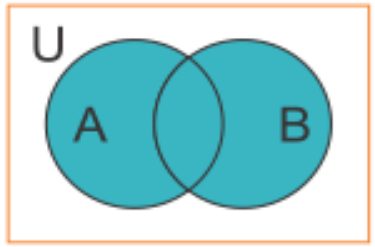
- A set is an unordered collection of distinct items.
- Unordered means that items are not stored in any particular order.
- Something is either in the set or not, but there's no notion of it being the first, second, or last item.
- Distinct means that any item appears in a set at most once; in other words, there are no duplicates.

Basics from Set Theory

Venn Diagrams: Shows logical relations between a finite collection of sets.

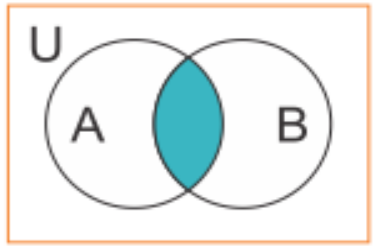
Union of Sets - Consists of all elements in sets A and B.

$A \cup B$



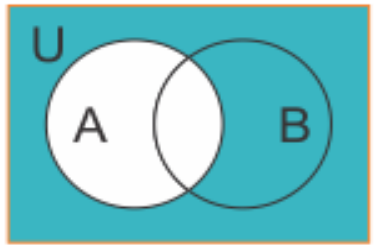
Intersection of Sets - Consists of only the common elements in sets A and B.

$A \cap B$



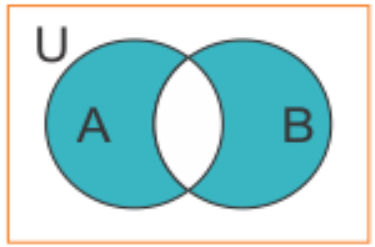
Complement of Set - Consists of elements which do not belong to set A.

$\overline{A}$, A^c or A'



Symmetric Difference of Sets - Consists of elements in sets A and B but not in their intersection.

$A \triangle B$ or $A \ominus B$



Sets in Python

- Python provides some simple data structures for grouping together multiple values, and integrates them with the rest of the language. These data structures are called collections.
- A set is an unordered collection in which each value occurs at most once.
- You can use curly braces to give an expression whose value is a set. Python prints sets using curly braces.
- {1+2, 3, "a"}

Sets in Python

- Note that duplicates are eliminated
- The order in which the elements of the output are printed does not necessarily match the order of the input elements.
- The cardinality of a set S is the number of elements in the set.
- In Python, the cardinality of a set is obtained using the procedure len(·)

Frozen Sets

- Frozen set is just an immutable version of a Python set object.
- While elements of a set can be modified at any time, elements of frozen set remains the same after creation.
- The syntax of frozenset() method is:

  - frozenset([iterable])

Summing

- The sum of elements of collection of values is obtained using the procedure sum(·).
- If you want to start the sum not at zero but at some other value, supply that value as a second argument to sum(·):

Testing Set Membership

- Membership in a set can be tested using the in operator and the not in operator.
- If S is a set, x in S is a Boolean expression that evaluates to True if the value of x is a member of the set S, and False otherwise. The value of a not in expression is just the opposite.

Set Union and Intersection

- The union of two sets S and T is a new set that contains every value that is a member of S or a member of T(or both).
- Python uses the vertical bar | as the union operator.
- The intersection of S and T is a new set that contains every value that is a member of both S and T.
- Python uses the ampersand & as the intersection operator.

Mutating a Set

- A value that can be altered is a mutable value.
- Sets are mutable: elements can be added and removed using the add and remove methods
- The operations add(·) and remove(·) are methods.
- Method is a procedure that takes an extra argument, the value of the expression to the left of the dot.
- Python provides a method update(...) to add to a set all the elements of another collection (e.g. a set or a list)
- We can intersect a set with another collection, removing from the set all elements not in the other collection.

Multiple variables: same set

- Suppose two variables are bound to the same value.
- A mutation to the value made through one variable is seen by the other variable.
- This behavior reflects the fact that Python stores only one copy of the underlying data structure.
- However, Python provides a method for copying a collection such as a set.

Set Comprehensions

- Python provides for expressions called comprehensions that let you build collections out of other collections.
- Comprehensions are useful in constructing expression whose value is a collection, and they mimic traditional mathematical notation.
- The iterable is a set in this case

More comprehensions

- Using the union operator |or the intersection operator &, you can write set expressions for the union or intersection of two sets, and use such expressions in a comprehension.
- By adding the phrase *if* condition at the end of the comprehension (before the closing brace “}”), you can skip some of the values in the set being iterated over.
- You can write a comprehension that iterates over the Cartesian product of two sets. This is also called double-comprehension.

Empty Set

- The empty set is represented by set().
- You would think that {} would work but, as we will see, that notation is used for something else.

Problem 1

- Write a Python program to iteration over elements of a set.

Problem 2

- Write a Python program to add member(s) in a set.

Problem 3

- Write a Python program to create a symmetric difference.

Problem 4

- If A = {1, 3, 5}, B = {3, 5, 6}. Show that A∪ $B \neq A \cap B$.

Next Class

- Problems on Sets
- In Class exercise