CS134 Lecture 15:
Tuples and Set Examples

Announcements & Logistics

- No HW due next Monday
- **Midterm reminders:**
  - **Review:** **Monday 3/11** from 7-9pm
  - **Exam Thurs 3/14** from 6-7:30pm OR 8-9:30pm
  - Both exam and review are in Bronfman Auditorium
  - Exam only includes material up to this week
  - Sample Exam posted!
- New Instructor Help Hours Schedule
  - Wednesday 1-4, Thursday 1-4

Do You Have Any Questions?

Last Time: Aliasing

- Describe how scope works when lists are passed as function parameters (interaction between scope and aliasing)
- Explore two new Python types:
  - tuples: *immutable* *ordered* alternative to lists
  - sets: *mutable* *unordered* collection (if time permits)

Today's Plan

- Finish up presentation of sets
- Write some code together (using tuples and sets) to solve familiar problems.

Sets

New Unordered Data Structure: Sets

- Sets are ***mutable***, **unordered** collections of **immutable** objects
  - Sets can change (e.g., we can add and remove items), but an item cannot be changed once the item is added to the set
- Sets are written as comma separated values between curly braces { }
- Elements in a set must be **unique** and **immutable**
  - Sets can be an effective way of **eliminating duplicate values**

```
>>> nums = {42, 17, 8, 57, 23}
>>> flowers = {"tulips", "daffodils", "asters", "daisies"}
>>> empty_set = set() # empty set
```

New Unordered Data Structure: Sets

- **Question:** What is the potential downside of removing duplicates w/sets?

```
>>> first_choice = {'a', 'b', 'a', 'a', 'b', 'c'}
>>> uniques = set(first_choice)
>>> uniques
# ???
>>> set("aabrakadabra")
# ???
```

New Unordered Data Structure: Sets

- **Question:** What is the potential downside of removing duplicates w/sets?
  - Might lose the ordering of elements

```
>>> first_choice = {'a', 'b', 'a', 'a', 'b', 'c'}
>>> uniques = set(first_choice)
>>> uniques
{'a', 'b', 'c'}
>>> set("aabrakadabra")
{'a', 'b', 'd', 'k', 'r'}
```

Sets: Creating New Sets

- There are two ways to create a new set:
  - By placing curly brackets around elements:

```
>>> set_brack = {'aardvark'}
>>> set_brack
{'aardvark'}
```

  - By converting an iterable collection into a set:

```
>>> set_func = set('aardvark')
>>> set_func
{'d', 'v', 'a', 'r', 'k'}
```

Why letters here instead of the word?

Strings are iterable collection!

- And only one way to create an empty set:

```
>>> empty_set = set()
>>> empty_set
set()
```

Sets: Membership and Iteration

- Can check membership in a **set** using `in`, `not in`
- Can check length of a set using `len()`
- Can iterate over values in a loop (order will be arbitrary)

```
>>> nums = {42, 17, 8, 57, 23}
>>> flowers = {"tulips", "daffodils", "asters", "daisies"}
>>> 16 in nums
False
>>> "asters" in flowers
True
>>> len(flowers)
4
>>> # iterable
>>> for f in flowers:
>>> ...   print(f)
```

```
tulips
daisies
daffodils
asters
```

Sets are Unordered

- Therefore we **cannot**:
  - Index into a set (no notion of "position")
  - Concatenate (**+**) two sets (concatenation implies ordering)
  - Create a set of ***mutable*** objects:
    - Such as lists, sets, and *dictionaries* (foreshadowing...)

```
>>> {[3, 2], [1, 5, 4]}
TypeError
----> 1 {[3, 2], [1, 5, 4]}

TypeError: unhashable type: 'list'
```

Set Operations

- The usual operations you think of in set theory are implemented as follows

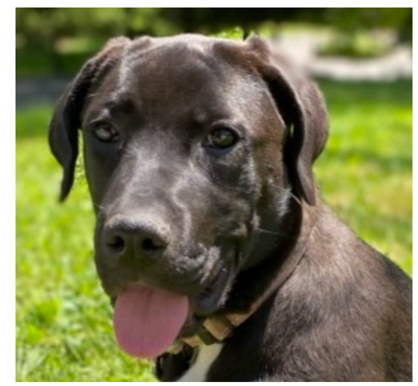
The following operations always return a new set.

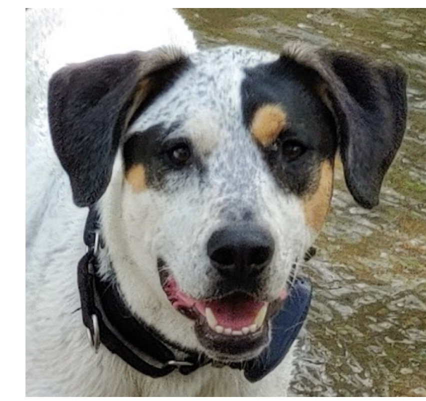
- `s1 | s2` **(Set Union)**
  - Returns a new set that has all elements that are either in `s1` or `s2`
- `s1 & s2` **(Set Intersection)**
  - Returns a new set that has all the elements that are common to both sets.
- `s1 - s2` **(Set Difference)**
  - Returns a new set that has all the elements of `s1` that are not in `s2`
- `s1 |= s2`, `s1 &= s2`, `s1 -= s2` are versions of `|, &, -` that mutate `s1` to become the result of the operation on the two sets.

Set Operations

```
>>> cs134_dogs = {"wally", "pixel", "linus", "chelsea", "sally", "artie"}
```





```
>>> peanuts = {"sally", "linus", "charlie", "franklin", "lucy", "patty"}
```

Set Operations

```
>>> cs134_dogs = {"wally", "pixel", "linus", "chelsea", "sally", "artie"}
>>> peanuts = {"sally", "linus", "charlie", "franklin", "lucy", "patty"}

>>> union = cs134_dogs | peanuts
>>> union
{'sally', 'wally', 'patty', 'chelsea', 'pixel',
'franklin', 'lucy', 'artie', 'linus', 'charlie'}

>>> intersect = cs134_dogs & peanuts
>>> intersect
{'sally', 'linus'}

>>> diff = cs134_dogs - peanuts
>>> diff
{'chelsea', 'artie', 'wally', 'pixel'}

>>> cs134_dogs
{'sally', 'wally', 'linus', 'artie', 'chelsea', 'pixel'}
```

Original set is unchanged!

Set Operations: Mutators

```
>>> cs134_dogs = {"wally", "pixel", "linus", "chelsea", "sally", "artie"}
>>> peanuts = {"sally", "linus", "charlie", "franklin", "lucy", "patty"}
```

```
>>> cs134_dogs |= peanuts
>>> cs134_dogs
```
Original set is mutated!

```
{'sally', 'wally', 'patty', 'chelsea', 'pixel',
'franklin', 'lucy', 'artie', 'linus', 'charlie'}
```

```
>>> cs134_dogs = {"wally", "pixel", "linus", "chelsea", "sally", "artie"}
>>> cs134_dogs &= peanuts
>>> cs134_dogs
```
Original set is mutated!

```
{'sally', 'linus'}
```

```
>>> cs134_dogs = {"wally", "pixel", "linus", "chelsea", "sally", "artie"}
>>> cs134_dogs -= peanuts
>>> cs134_dogs
```
Original set is mutated!

```
{'wally', 'artie', 'chelsea', 'pixel'}
```

Set Operations

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- `s1 |= s2`, `s1 &= s2`, `s1 -= s2` are versions of `|, &, -` that mutate `s1` to become the result of the operation on the two sets.

Set Examples
(live coding)

voting.py

Tuple Examples
(live coding)

madlibs.py