# Structures: Sets and Tuples

## CPSC 231: Introduction to Computer Science for Computer Science Majors I
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# Tuples?

# What is a Tuple?

- A collection of values
  - Values
    - May all have the same type, or
    - May have different types
  - Each item is referred to as an element
  - Each element has an index (ORDERED)
    - Unique integer identifying its position in the tuple
  - A tuple is one type of data structure
    - A mechanism for organizing related data

# Main thing to remember!

- Similar to lists, but
  - length cannot be changed
  - **Items cannot be modified (immutable)**
  - () empty tuple, (3,) length one tuple

```
aTuple = (1,"ICT",3.14)
```

# Tuples

- Like a list, a tuple is a sequence type that its elements can be of any other type
- Support many of the same operations as lists
- Unlike lists, tuples are used to store data that should not be changed.
- Format
  - <tuple name> = (<value 1>, <value 2>, ... , <value n>)
- Example

```
student = ('Marc', 123456789, 9.5)
print (student)
print (student[1])
#student[2] = 10
```

```
('Marc', 123456789, 9.5)
123456789
```

TypeError: 'tuple' object does not support item assignment

# Tuple

- Format:

  <list name> = (<value 1>, <value 2>, ... , <value n>)

Examples:

```
nums = (10.0, 9.0, 8.5, 5.0, 7.5)
letters = ('a', 'b', 'c', 'd', 'e', 'f', 'g')
names = ('Marc', 'Jim', 'Ken')
mixed = (1.0,1,"this",True)
```

By defining the tuple memory is allocated for it

names = (x,) → Singleton tuple of one time

Regular brackets () without comma are interpreted as empty tuple

# Tuple operations

| Operations | Example | Description |
|---|---|---|
| Indexing | name[i] | Access item by index |
| Slicing | name[start:end:step] | Get sub-tuple |
| Concatenation | names1+names2 | Join two tuples into larger tuple |
| ~~Update tuple~~ | Immutable | Use slicing to get sub-tuple<br>Use concatenation to get larger tuple |
| Length | len(name) | Get length of tuple |
| Repetition | name*x | Multiply to get tuple with int x copies of its contents in order |
| Membership | n in name | Boolean if item is in tuple at base level |
| Loop | for x in name :<br>print(x) | Iterate through each item in tuple |
| Index | name.index(“Carl”) | Returns first index of item “Carl” in tuple name |

# Tuple

- In effect when we return multiple values from a function we are using tuples
- The same

```
def foo():
        return x,y
def foo():
        return (x,y)
```

- A number of common languages don’t have tuples a structure like tuples, and are limited to returning a single pointer of data.

# Packing/Unpacking

- You can define a tuple without brackets. Python will interpret variables/expressions separated by commas.

x = 1,2

print(x) -> (1,2)

print(x[0]) -> 1

print(x[1]) -> 2

a,b = x

print(a) -> 1

print(b) -> 2

The process seen here is generally called packing, and unpacking

# What is a Set?

- A collection of values
  - Values
    - May all have the same type, or
    - May have different types
  - Each item is referred to as an element
  - ~~Each element has an index~~ UNORDERED
    - ~~Unique integer identifying its position in the list~~
  - A set is one type of data structure
    - A mechanism for organizing related data

# What is a Set?

- A set contains only immutable types
- A set only contains **unique!!!** elements
- A collection of values
  - Values
    - May all have the same type, or
    - May have different types
  - Each item is referred to as an element
  - ~~Each element has an index~~ UNORDERED
    - ~~Unique integer identifying its position in the list~~
  - A set is one type of data structure
    - A mechanism for organizing related data

# Set

- Unlike a list/tuple, a set is unordered
- The functions for a set are very different (we can’t index/slice)
- Unlike tuples, sets can change.
- Format
  - <set name> = {<value>, <value>, ... , <value>}
- Example
  - names = {“Albert”, Brian”, ”Carl”}

# Set

- Format:

<set name> = {<value 1>, <value 2>, ... , <value n>}

Examples:

nums = {10.0, 9.0, 8.5, 5.0, 7.5}

letters = {'a', 'b', 'c', 'd', 'e', 'f', ‘g’}

names = {'Marc', 'Jim', 'Ken’}

mixed = {1.0,1,”this”,True}

By defining the set memory is allocated for it

names = set() → Only way to declare an empty set

{} -> is interpreted as a empty dictionary

# Set operations

| Operations | Example | Description |
|---|---|---|
| Unique | x = {1,1,1,2,2,2,2} | x = {1,2} |
| Membership | n in name | Boolean if item is in set at base level |
| ~~Concatenation~~ | ~~names1+names2~~ | ~~Join two sets into larger set~~ |
| Update set | add(item)<br>update(set)<br>remove(item)<br>discard(item)<br>pop() | no change if duplicate<br>add all items from other set<br>error if no item<br>no error<br>random remove |
| Length | len(name) | Get length of tuple |
| ~~Repetition~~ | ~~name*x~~ | ~~Multiply to get set with int x copies of its contents in order~~ |
| Loop | for x in name :<br>  print(x) | Iterate through each item in tuple |

# Sets

- Why do we use sets?
  - Natural uniqueness can make some things quick (we can skip membership checks)
  - Sets are rather common in many pure mathematics, logic, philosophy, and computer science (especially AI)
  - Where have you seen sets visualized (Venn Diagrams!)

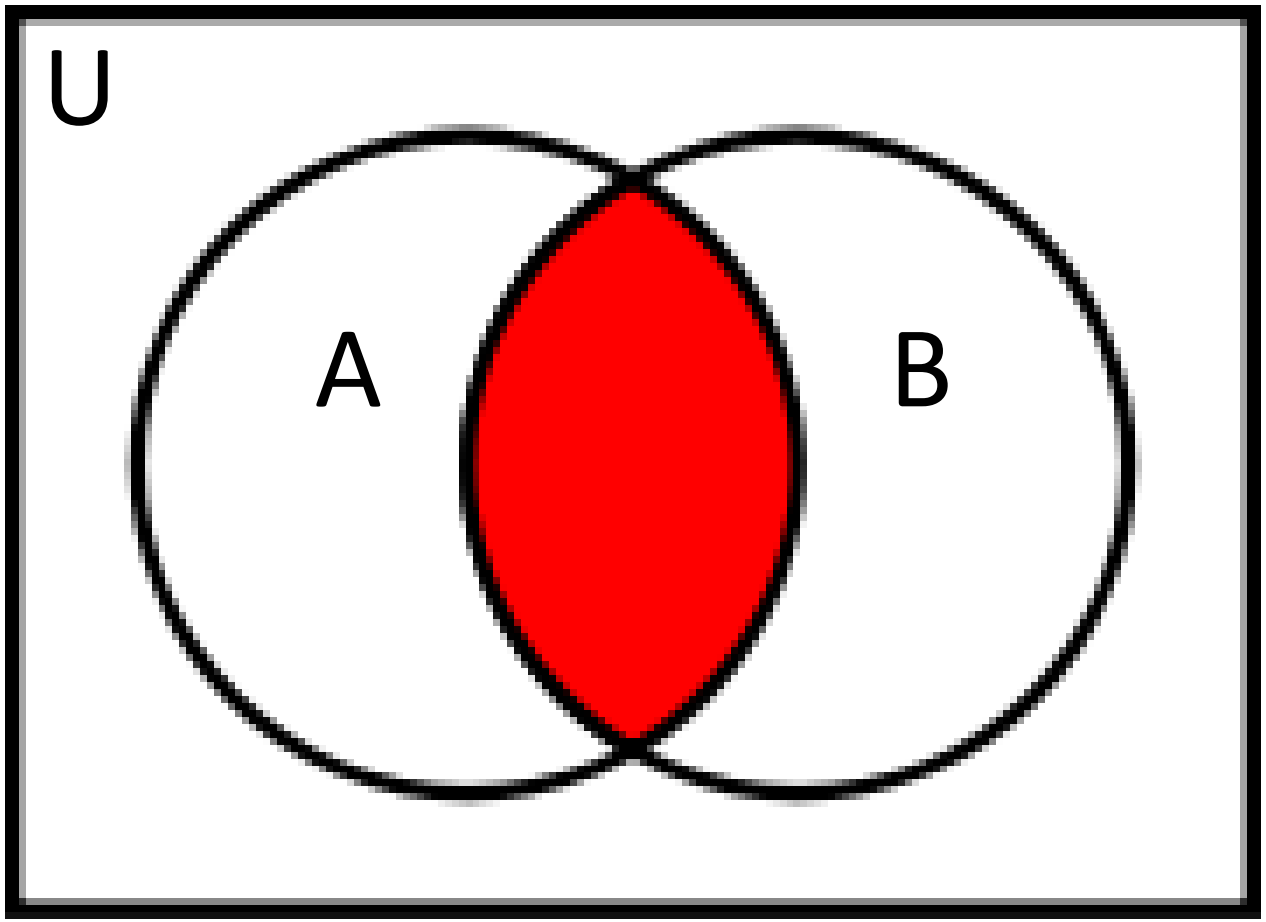
# Intersection (and)

Set Notation

$A \cap B$

Python

A & B



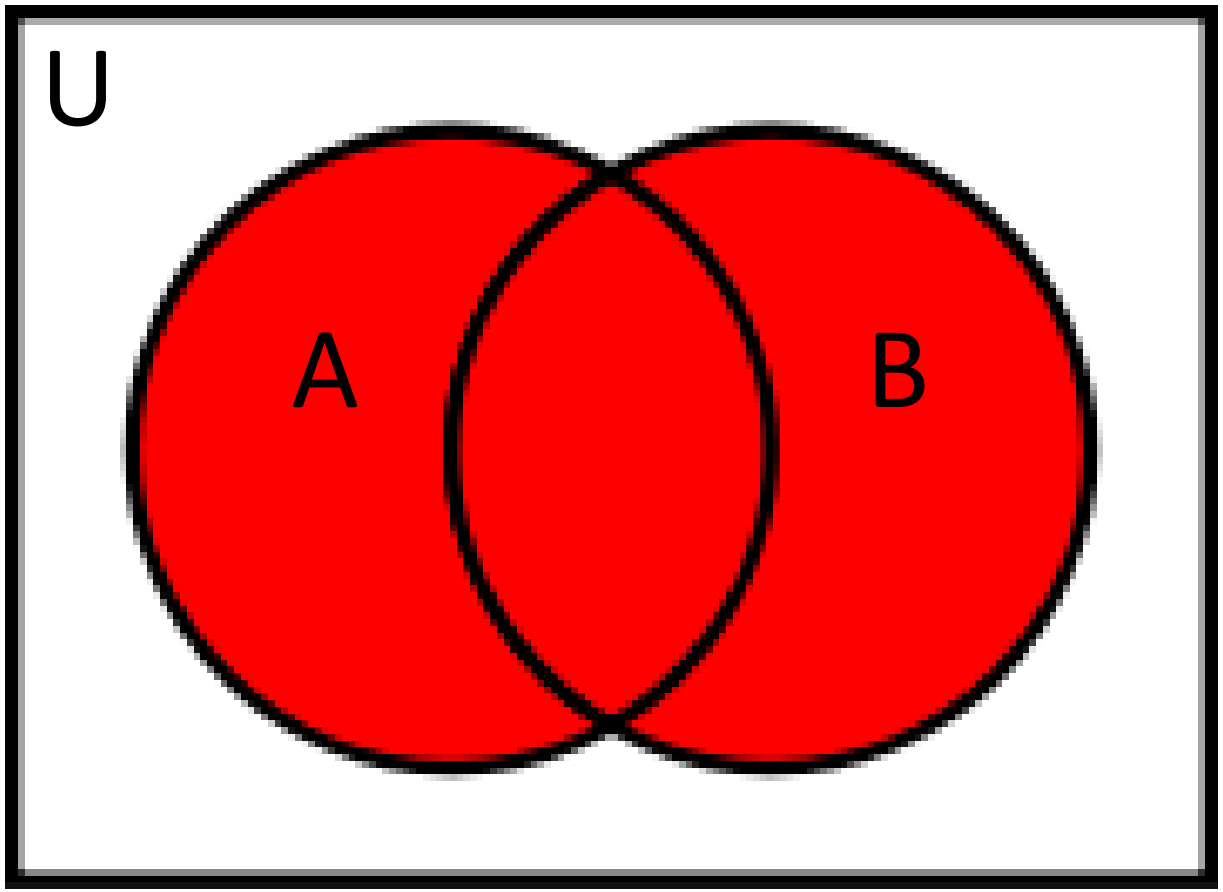
# Union (or)

Set Notation

$A \cup B$

Python

A | B



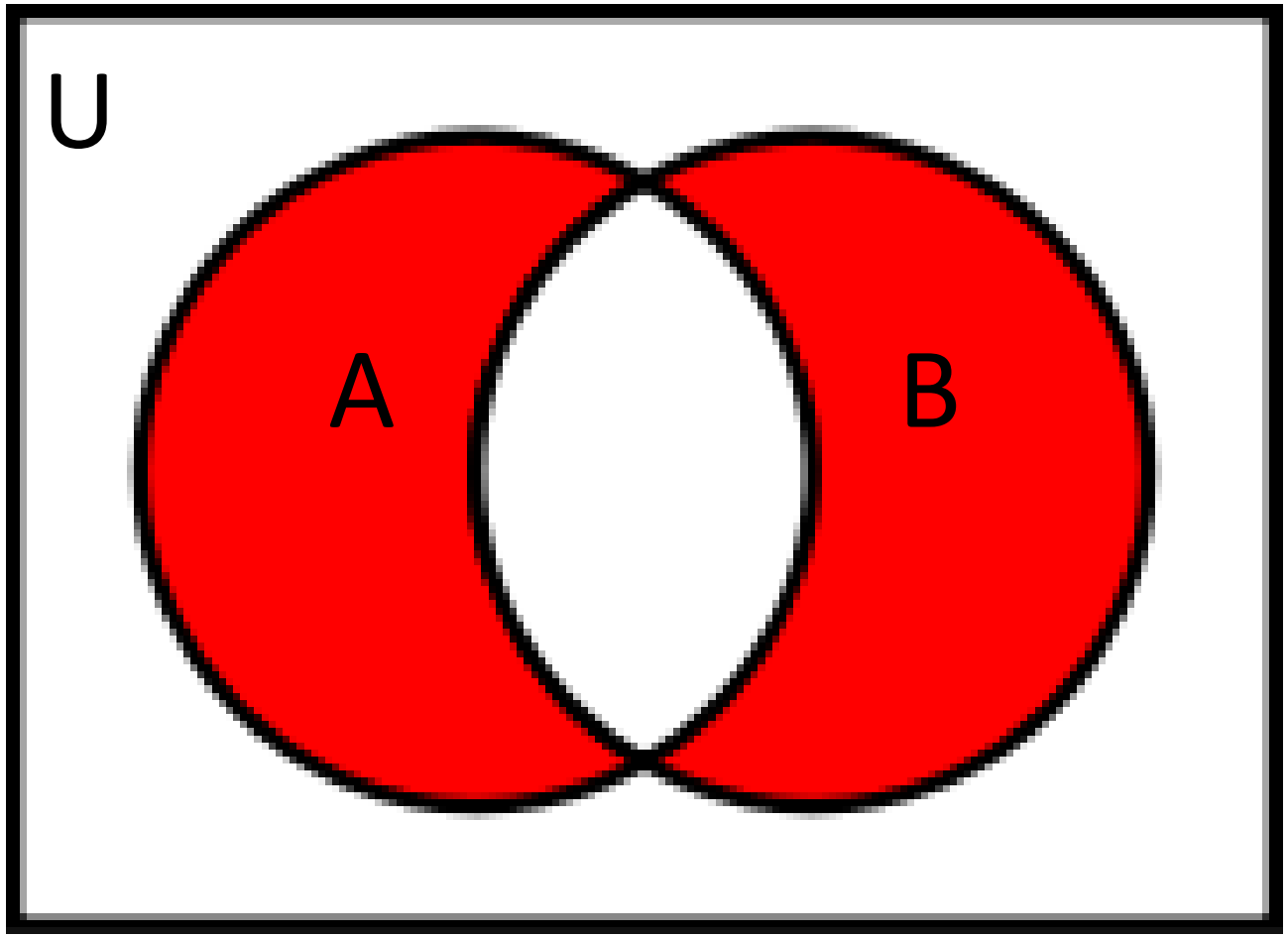
# Symmetric Difference (not and)

Set Notation

$A \triangle B$

Python

A ^ B



# Complement Difference

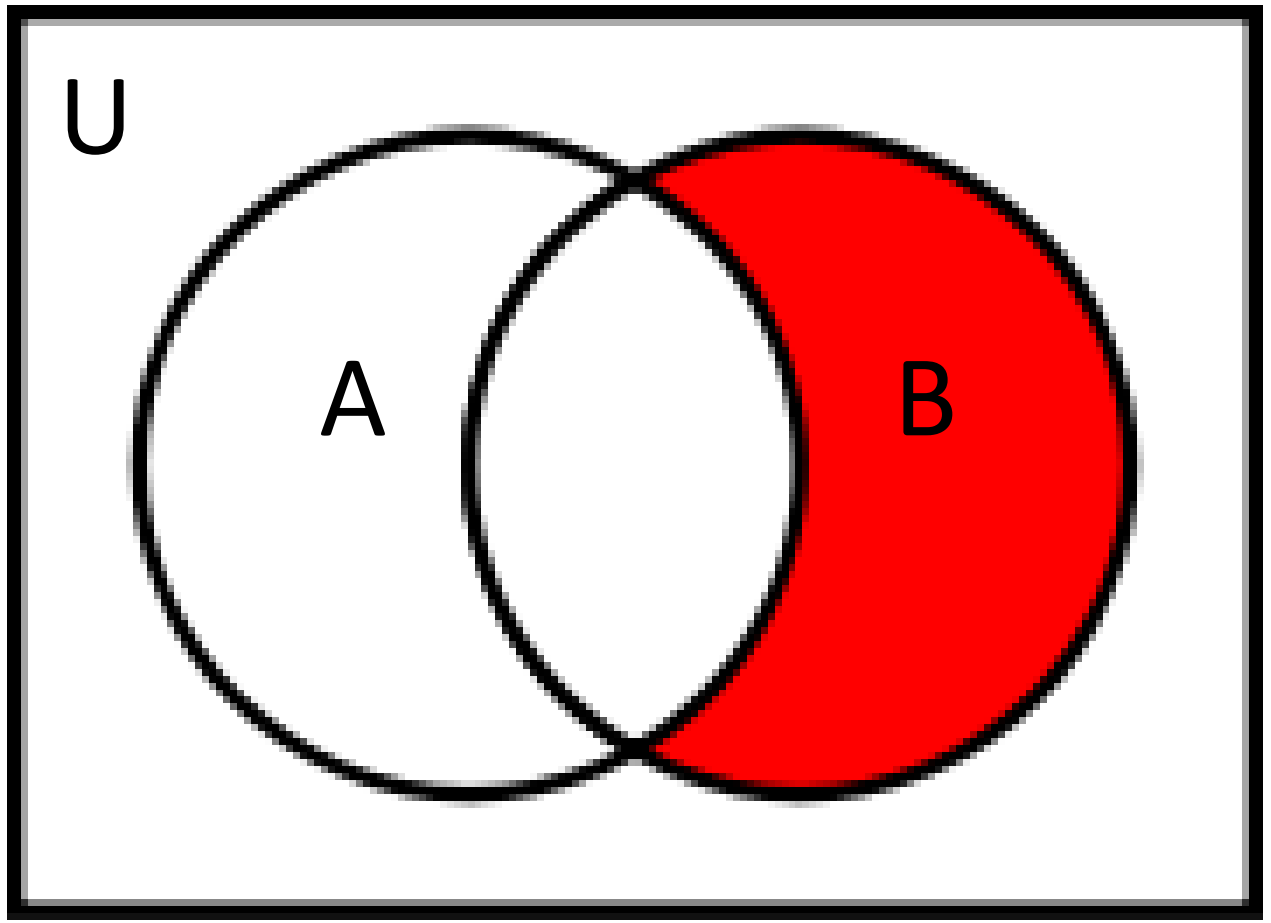
Set Notation

B \ A

$A^C \cap$ B

Python

B - A



# Set questions

| Operations | Example | Description |
|---|---|---|
| Is disjoint | x.isdisjoint(y) | True if neither x,y share an element |
| Is subset | x.issubset(y) OR x <= y | True if all elements in x are in y |
| Is superset | x.issuperset(y) OR x >= y | True if all in elements in y are in x |
| Equal | x==y | True if all elements in x are in y, all elements in y are in x |
| Not equal | x != y | True if at least one element is not in both x and y |
| Proper subset | x < y | x<=y and x!=y |
| Proper superset | x > y | x>=y and x!=y |

# Onward to … dictionaries.

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