# Decomposition

# Announcements

# Modular Design

# Separation of Concerns

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A design principle: Isolate different parts of a program that address different concerns

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A modular component can be developed and tested independently

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**Hog**

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**Hog**


- Game rules

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**Hog**


- Game rules
- Ordering of events

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**Hog**

| Hog Game Simulator | Game Commentary | Player Strategies |
| --- | --- | --- |

- Game rules
- Ordering of events
- State tracking to determine the winner

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**Hog**

| Hog Game Simulator | Game Commentary | Player Strategies |
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| • Game rules<br>• Ordering of events<br>• State tracking to determine the winner | • Event descriptions | |

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| • Game rules<br>• Ordering of events<br>• State tracking to determine the winner | • Event descriptions<br>• State tracking to generate commentary | |

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**Ants**

| Ants Game Simulator | Actions | Tunnel Structure |
|---|---|---|

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| • Order of actions<br>• Food tracking<br>• Game ending conditions | | |

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**Ants**

| Ants Game Simulator | Actions | Tunnel Structure |
|---|---|---|
| • Order of actions<br>• Food tracking<br>• Game ending conditions | • Characteristics of different ants & bees | |

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| • Order of actions<br>• Food tracking<br>• Game ending conditions | • Characteristics of different ants & bees | • Entrances & exits<br>• Locations of insects |

# Example: Restaurant Search

## Restaurant Search Data

Given the following data, look up a restaurant by name and show related restaurants.

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```
{"business_id": "gclB3ED6uk6viWlolSb_uA", "name": "Cafe 3", "stars": 2.0, "price": 1, ...}
```

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{"business_id": "WXKx2I2SEzBpeUGtDMCS8A", "name": "La Cascada Taqueria", "stars": 3.0, "price": 2}
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{"business_id": "gclB3ED6uk6viWlolSb_uA", "user_id": "xVocUszkZtAqCxgWak3xVQ", "stars": 1, "text":
 "Cafe 3 (or Cafe Tre, as I like to say) used to be the bomb diggity when I first lived in the dorms
  but sadly, quality has dramatically decreased over the years....", "date": "2012-01-19", ...}
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(Demo)

# Example: Similar Restaurants

# Discussion Question: Most Similar Restaurants

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Implement **similar**, a **Restaurant** method that takes a positive integer **k** and a function **similarity** that takes two restaurants as arguments and returns a number. Higher **similarity** values indicate more similar restaurants. The **similar** method returns a list containing the **k** most similar restaurants according to the **similarity** function, but not containing **self**.

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def similar(self, k, similarity):
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def similar(self, k, similarity):
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def similar(self, k, similarity):
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    others = list(Restaurant.all)
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```

---

**sorted**(iterable, /, *, key=None, reverse=False)
    Return a new list containing all items from the iterable in ascending order.

    A custom key function can be supplied to customize the sort order, and the reverse flag can be set to request the result in descending order.

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def similar(self, k, similarity):
    "Return the K most similar restaurants to SELF, using SIMILARITY for comparison."

    others = list(Restaurant.all)

    others.____remove____(_______________)

    return sorted(others, key=_____________________________________)_________________
```

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    others = list(Restaurant.all)

    others.____remove____(____self_____)

    return sorted(others, key=____lambda r: -similarity(self, r)_____)______[:k]_______
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# Example: Reading Files

(Demo)

# Set Intersection

## Linear-Time Intersection of Sorted Lists

```
Given two sorted lists with no repeats, return the number of elements that appear in both.
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| 3 | 4 | 6 | 7 | 9 | 10 |
|---|---|---|---|---|---|

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| 3 | 4 | 6 | 7 | 9 | 10 |
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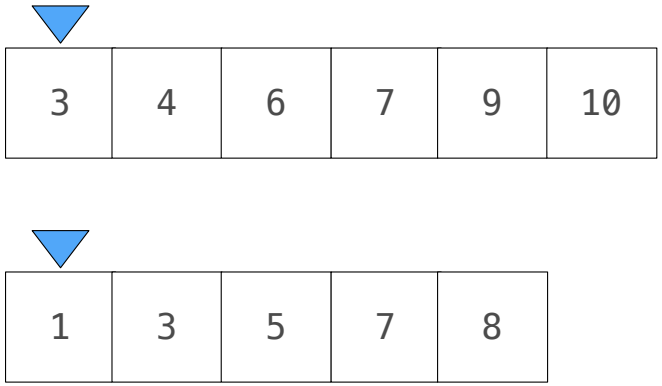
| 1 | 3 | 5 | 7 | 8 |
|---|---|---|---|---|

# Linear-Time Intersection of Sorted Lists

Given two sorted lists with no repeats, return the number of elements that appear in both.



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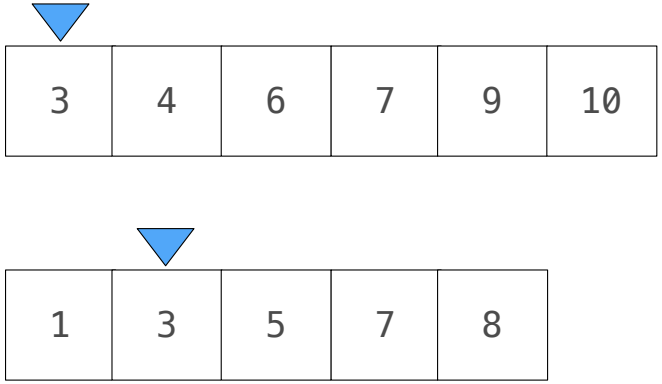

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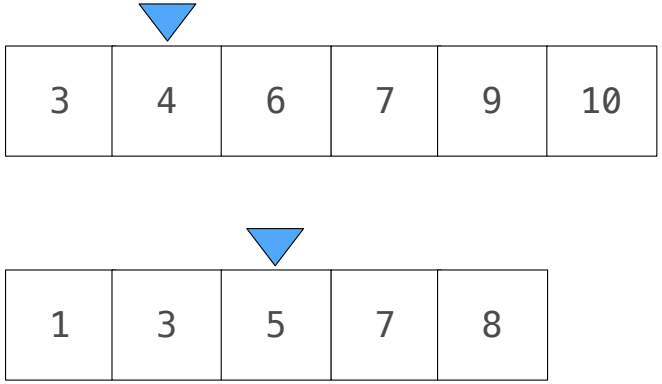

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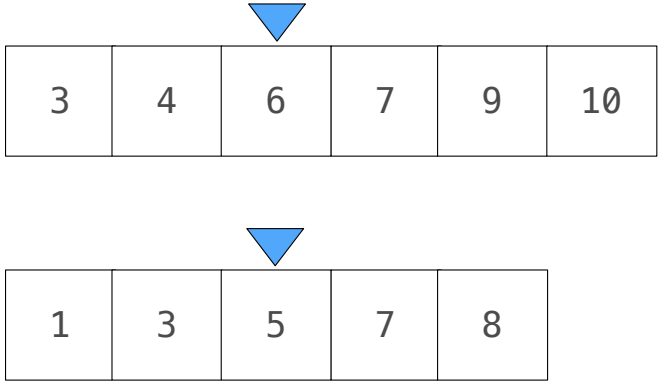

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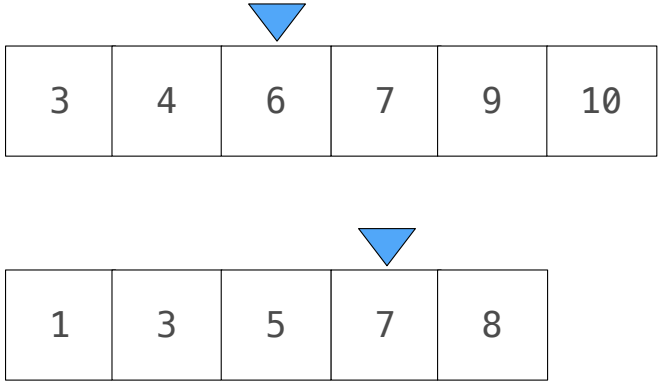

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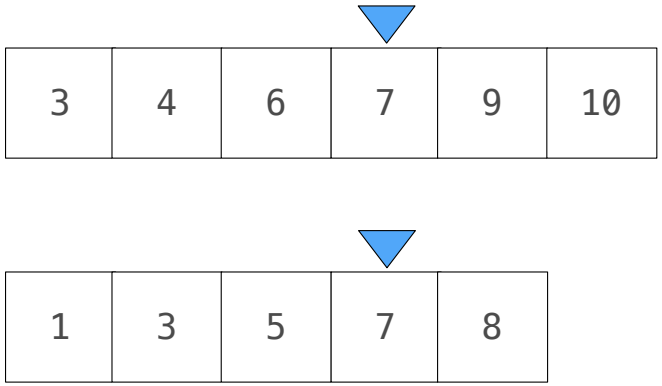

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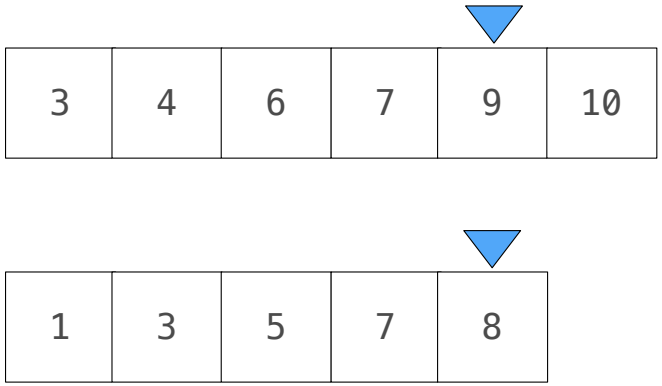

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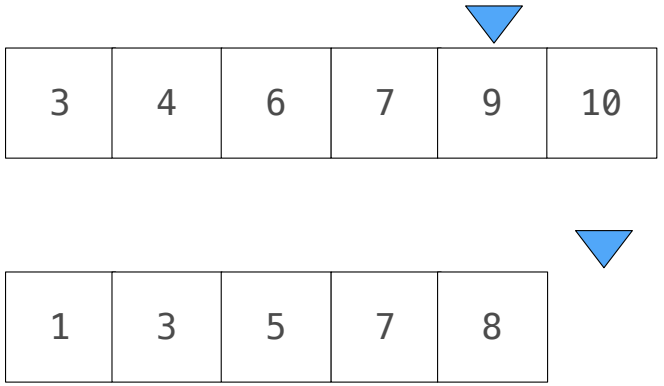

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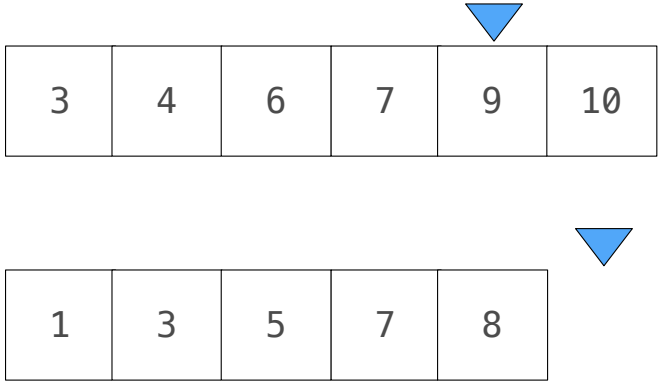


```
def fast_overlap(s, t):
    """Return the overlap between sorted S and sorted T.

    >>> fast_overlap([3, 4, 6, 7, 9, 10], [1, 3, 5, 7, 8])
    2
    """
    i, j, count = 0, 0, 0

    while ____len(s) > i and len(t) > j____:
        if s[i] == t[j]:
            count, i, j = ____count + 1, i +1, j +1____
        elif s[i] < t[j]:
            ____i += 1____
        else:
            ____j += 1____
    return count
```

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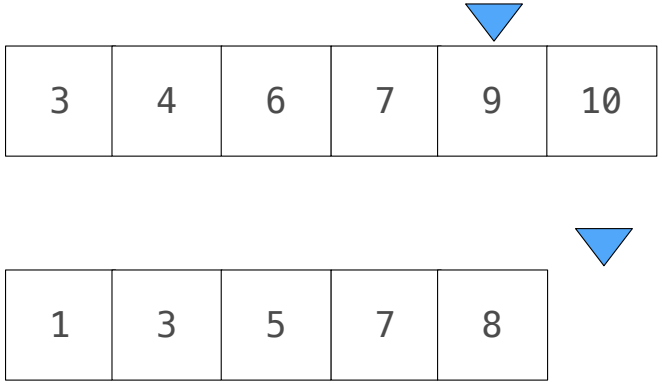


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    i, j, count = 0, 0, 0

    while ____________i < len(s) and j < len(t)____________:
        if s[i] == t[j]:
            count, i, j = ____________________________
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            ____________________________________________
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    return count
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# Linear-Time Intersection of Sorted Lists

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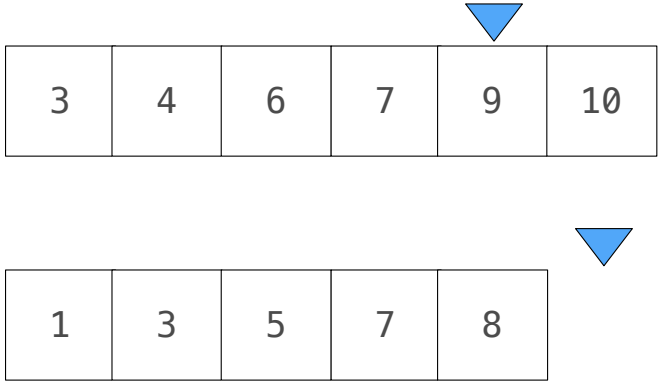


```
def fast_overlap(s, t):
    """Return the overlap between sorted S and sorted T.

    >>> fast_overlap([3, 4, 6, 7, 9, 10], [1, 3, 5, 7, 8])
    2
    """
    i, j, count = 0, 0, 0

    while ____________________________________________:
        if s[i] == t[j]:
            count, i, j = ____________________________
        elif s[i] < t[j]:
            ____________________________________________
        else:
            ____________________________________________
    return count
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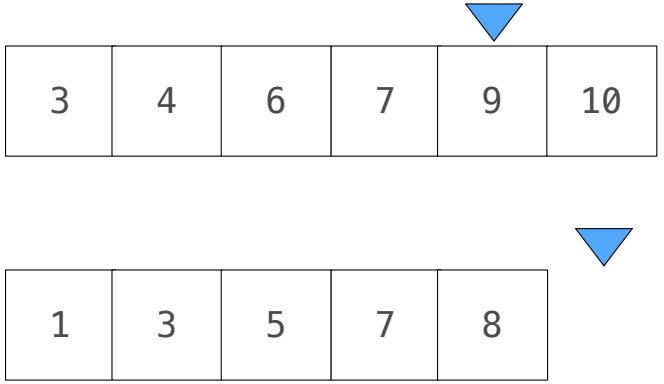


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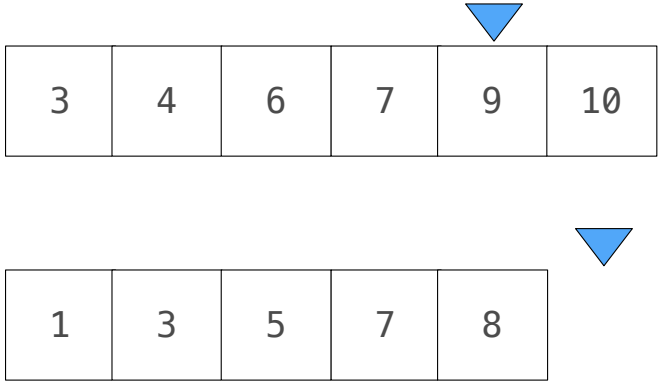


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```

i < len(s) and j < len(t)

count + 1, i + 1, j + 1

i = i + 1

j = j + 1

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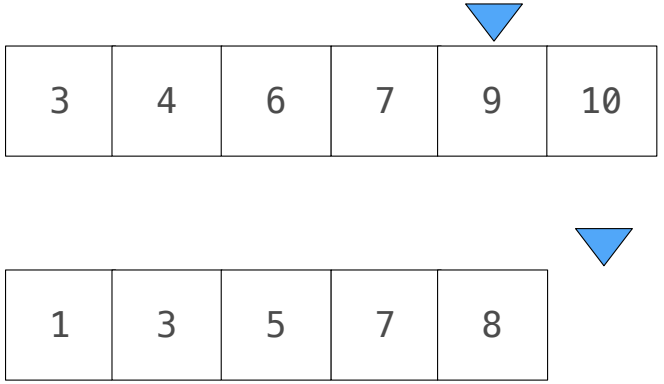


(Demo)

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    """
    i, j, count = 0, 0, 0

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```

i < len(s) and j < len(t)

count + 1, i + 1, j + 1

i = i + 1

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# Sets

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One more built-in Python container type

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```
>>> s = {'one', 'two', 'three', 'four', 'four'}
```

# Sets

One more built-in Python container type

- Set literals are enclosed in braces
- Duplicate elements are removed on construction
- Sets have arbitrary order

```
>>> s = {'one', 'two', 'three', 'four', 'four'}
>>> s
{'three', 'one', 'four', 'two'}
```

# Sets

One more built-in Python container type

- Set literals are enclosed in braces
- Duplicate elements are removed on construction
- Sets have arbitrary order

```
>>> s = {'one', 'two', 'three', 'four', 'four'}
>>> s
{'three', 'one', 'four', 'two'}
>>> 'three' in s
True
```

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One more built-in Python container type

- Set literals are enclosed in braces
- Duplicate elements are removed on construction
- Sets have arbitrary order

```
>>> s = {'one', 'two', 'three', 'four', 'four'}
>>> s
{'three', 'one', 'four', 'two'}
>>> 'three' in s
True
>>> len(s)
4
```

# Sets

One more built-in Python container type

- Set literals are enclosed in braces
- Duplicate elements are removed on construction
- Sets have arbitrary order

```
>>> s = {'one', 'two', 'three', 'four', 'four'}
>>> s
{'three', 'one', 'four', 'two'}
>>> 'three' in s
True
>>> len(s)
4
>>> s.union({'one', 'five'})
{'three', 'five', 'one', 'four', 'two'}
```

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- Sets have arbitrary order

```
>>> s = {'one', 'two', 'three', 'four', 'four'}
>>> s
{'three', 'one', 'four', 'two'}
>>> 'three' in s
True
>>> len(s)
4
>>> s.union({'one', 'five'})
{'three', 'five', 'one', 'four', 'two'}
>>> s.intersection({'six', 'five', 'four', 'three'})
{'three', 'four'}
```

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- Sets have arbitrary order

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>>> s
{'three', 'one', 'four', 'two'}
>>> 'three' in s
True
>>> len(s)
4
>>> s.union({'one', 'five'})
{'three', 'five', 'one', 'four', 'two'}
>>> s.intersection({'six', 'five', 'four', 'three'})
{'three', 'four'}
>>> s
{'three', 'one', 'four', 'two'}
```