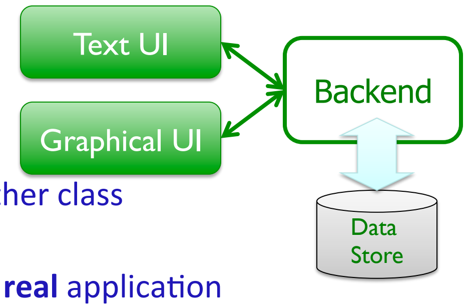
Reviewing Lab 10



- Created two classes
  - Used one class within another class
  - Tested them
  - Example of a backend to a **real** application
    - Could add a different user interface
- “Good judgment comes from experience”
  - Test methods after writing method
  - Remember your data types
  - Refer to the data type’s API
- What could you do to improve your development process?

Review

- We discussed two different search techniques:
  - What were they?
  - How do they compare?

Review: Search Using `in` Review

- Iterates through a list, checking if the element is found
- Known as ***linear search***
- **Implementation:**

```
def linearSearch(searchlist, key):
    for elem in searchlist:
        if elem == key:
            return True
    return False
```

value	8	5	3	7
pos	0	1	2	3

What are the strengths and weaknesses of implementing search this way?

`search.py`

Review: Linear Search

- **Overview**: Iterates through a list, checking if the element is found
- **Benefits:**
  - Works on *any* list
- **Drawbacks**:
  - **Slow**, on average: needs to check each element of list if the element is not in the list

Review: Binary Search: Eliminate Half the Possibilities

- Repeat until find value (or looked through all values)
  - Guess middle *value* of possibilities
    - (not middle *position*)
  - If match, found!
  - Otherwise, find out too high or too low
  - Modify your possibilities
    - Eliminate the possibilities from your number and higher/lower, as appropriate
- Known as **Binary Search**

Binary Search Implementation

```
def search(searchlist, key):
    low=0
    high = len(searchlist)-1
    while :
        mid = (low+high)//2
        if searchlist[mid] == key:
            return mid
        elif key > searchlist[mid]:
            low = mid+1
        else:
            high = mid-1
```

Our condition?
What if not found?

search2.py

Binary Search Implementation

```
def search(searchlist, key):
   low=0
   high = len(searchlist)-1
   while low <= high :
      mid = (low+high)//2
      if searchlist[mid] == key:
         return mid    # return True
      elif key > searchlist[mid]:
         low = mid+1
      else:
         high = mid-1
   return -1    # return False
```

If you just want to know if it's in the list

search2.py

Binary Search

- Example of a ***Divide and Conquer*** algorithm
  - Break into smaller pieces that you can solve
- Benefits:
  - Faster to find elements (especially with larger lists)
- Drawbacks:
  - Requires that data can be compared
    - `__lt__, __eq__` methods implemented by the class (or another solution)
  - List **must** be sorted before searching
    - Takes time to sort

Key Questions in Computer Science

- How can we efficiently organize data?
- How can we efficiently search for data, given various constraints?
  - Example: data may or may not be sortable
- What are the tradeoffs?

Empirical Study of Search Techniques

Goal: Determine which technique is better under various circumstances

- How long does it take to find various keys?
  - **Measure** by the number of comparisons
  - Vary the size of the list and the keys
  - What are good tests for the lists and the keys?

`search_compare.py`

Empirical Study of Search Techniques

- Analyzing Results …
  - By how much did the number of comparisons for *linear search* vary?
  - By how much did the number of comparisons for *binary search* vary?
- What conclusions can you draw from these results?

`search_compare.py`

Search Strategies Summary

- Which search strategy should I use under the following circumstances?
  - I have a short list
  - I have a long list
  - I have a long sorted list

Search Strategies Summary

- Which search strategy should I use under the following circumstances?
  - I have a short list
    - How short? How many searches? Linear (`in`)
  - I have a long list
    - Linear (`in`) - because don't know if in order, comparable
    - Alternatively, may want to sort the list and *then* perform binary search, if sorting first won't be more effort than just sorting.
  - I have a long sorted list
    - Binary

Extensions to Search

In FaceSpace, we want to find people who have a certain name.

Consider what happens when **`searchlist`** is a list of *Persons* and key is a name (a `str`)

We want to find a `Person` whose name matches the key and return the *Person*

List of `Person` objects

0	1	2	3	4
`Person` Id:“1” “Gal”	`Person` Id:“2” “Natalie”	`Person` Id:“3” “Chris”	`Person` Id: “4” “Ben”	`Person` Id: “5” “Samuel”

Example: looking for a person with the name “Chris”…

List of `Person` objects

0	1	2	3	4
`Person` Id:“1” “Gal”	`Person` Id:“2” “Natalie”	`Person` Id:“3” “Chris”	`Person` Id: “4” “Ben”	`Person` Id: “5” “Samuel”

0	1	2	3	4
`Person` Id: “4” “Ben”	`Person` Id:“3” “Chris”	`Person` Id: “1” “Gal”	`Person` Id:“2” “Natalie”	`Person` Id:“5” “Samuel”

Sorted by name using:

```
personList.sort(key=Person.getName)
```

Extensions to Solutio

Consider what happens when **`searchlist`** is a list of *`Persons`*, ***`key`*** is a ***`str`*** representing the name

- Goal: find a person with a certain name

```python
def search(searchlist, key):
   low=0
   high = len(searchlist)-1
   while low <= high :
      mid = (low+high)//2
      if searchlist[mid] == key:
         return mid
      elif key > searchlist[mid]:
         # look in upper half
         low = mid+1
      else:
         # look in lower half
         high = mid-1
   return -1
```

0	1	2	3	4
Person Id: “4” “Ben”	Person Id:“3” “Chris”	Person Id: “1” “Gal”	Person Id:“2” “Natalie”	Person Id:“5” “Samuel”

Dec 1, 2017

Extensions to Solutio

Consider what happens when **`searchlist`** is a list of *`Persons`*, ***`key`*** is a ***`str`*** representing the name

- Goal: find a *person* with a certain network

What can we do to make search results more intuitive?

```python
def search(searchlist, key):
   low=0
   high = len(searchlist)-1
   while low <= high :
      mid = (low+high)//2
      if searchlist[mid] == key:
         return mid
      elif key > searchlist[mid]:
         # look in upper half
         low = mid+1
      else:
         # look in lower half
         high = mid-1
   return -1
```

0	1	2	3	4
Person Id: “4” “Ben”	Person Id:“3” “Chris”	Person Id: “1” “Gal”	Person Id:“2” “Natalie”	Person Id:“5” “Samuel”

Dec 1, 2017

Summary of Extensions to Solution

- Check the *name* of the `Person` at the midpoint
- Represent, handle when no `Person` matches
- What could we do if more than one person has that name?

- Note: we're not implementing "name contains"
  - How could we implement that?

Looking Ahead

- Lab 10 due on Tuesday

Digital Humanities: Text Analysis

- What were the most interesting/surprising questions asked/answered?
- What are new questions you would like answered?
  - Could you implement those with what you currently know?

Google n-grams

- https://books.google.com/ngrams

Social Network Algorithms

- How did this article affect how you think about social media?
  - What impact does social media have on what you see?
- What other algorithms have an impact on what you think/see/feel?
- What are alterative ways that we could order the data?
- How would one implement one of those algorithms?

Next Week

- Tuesday: Finish UI for Social Networking App
  - Continuing development in Tuesday's lab
- Friday: One Laptop Per Child project

Review: Using list's `sort` method with a key

- We may not want to sort a list of objects by the "standard" way to sort objects
- Consider sorting strings: How does Python sort strings usually?
  - Alphabetically, upper-case first
- To alphabetize strings, regardless of case:

```
words.sort(key=str.lower)
```

Method to call to do comparison

`sort_ignore_case.py`

Extensions to Solution

```
def search(searchlist, key):
   low=0
   high = len(searchlist)-1
   while low <= high :
      mid = (low+high)//2
      if searchlist[mid] == key:
         return mid
      elif key > searchlist[mid]:
         # look in upper half
         low = mid+1
      else:
         # look in lower half
         high = mid-1
   return -1
```

Consider what happens when `searchlist` is a list of *`Persons`*

- What if we wanted ***all*** the `Persons` with the network that matched the key?
  - Assumes many different networks

Modifying Solution

```
def search(searchlist, key):
   low=0
   high = len(searchlist)-1
   while low <= high :
      mid = (low+high)//2
      if searchlist[mid] == key:
         return mid
      elif key > searchlist[mid]:
         # look in upper half
         low = mid+1
      else:
         # look in lower half
         high = mid-1
   return -1
```

Instead of a list of integers, what if we have a list of `Cards` and `key` is a `Card` object?

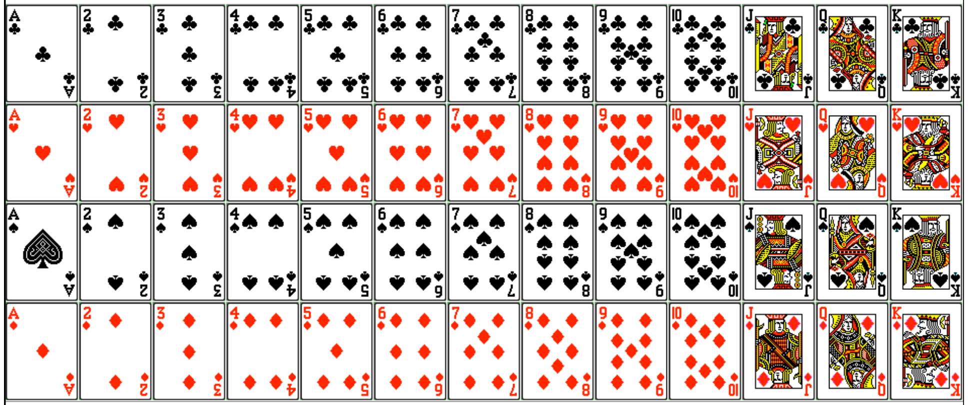
- What needs to change?
- What has to be done/verified in the `Card` class?

Example: player whose hand contains 2 of clubs starts game of Hearts

Card Example

Consider the cards as being in one list

0 1 2 3 4 …



Modifying Solution

Instead of a list of integers, what if we have a list of `Cards` and `key` is a `Card` object?

- What needs to change?
- What has to be done/verified in the `Card` class?

```
def search(searchlist, key):
   low=0
   high = len(searchlist)-1
   while low <= high :
      mid = (low+high)//2
      if searchlist[mid] == key:
         return mid
      elif key > searchlist[mid]:
         # look in upper half
         low = mid+1
      else:
         # look in lower half
         high = mid-1
   return -1
```

Example: player whose hand contains 2 of clubs starts game of Hearts

Comparing Cards

- What are some ways that we could compare `Card` objects?
- Do we always want one way to compare `Cards`?

Alternative sorting for `Card` class

- Create a function to use as the key
  - Not standard way to sort; probably shouldn't be part of the class

```
def totalOrderCardKeyFunction(card):
    """Returns the key to be used for comparison
    Parameter: card – a Card object"””

    # This key means that the cards will be ordered by their
    # rank and then their suit.
    key = "%2d %s" % (card.getRank(), card.getSuit())
    return key
```

- Pass the function name in as the key

```
# sort the cards using the key specified by the function
cards.sort(key=totalOrderCardKeyFunction)
```

Dec 1, 2017 Sprenkle - CSCI111 `card.py` 31