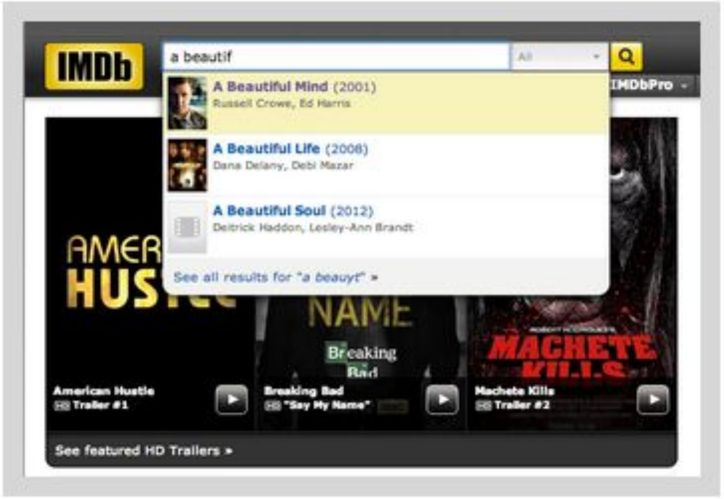
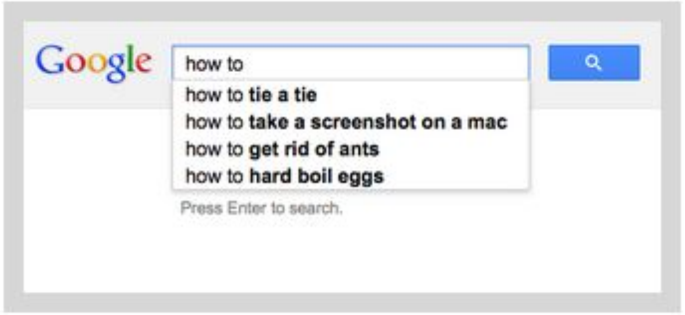
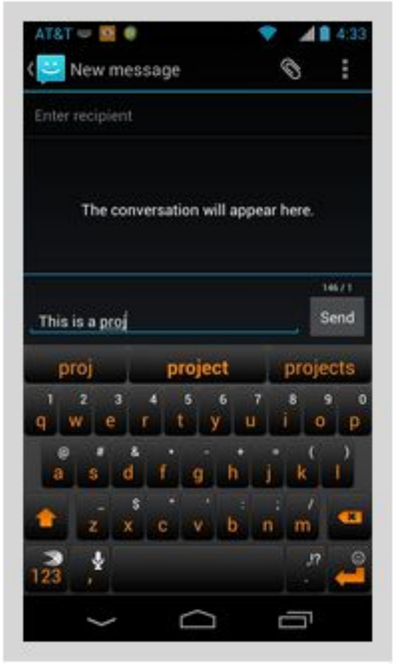
Discussion 6: Project 3

Kyle Hackett

AutoComplete Term
Binary Search Deluxe
Autocomplete


IMDb
a beautif
All
A Beautiful Mind (2001)
Russell Crowe, Ed Harris
A Beautiful Life (2008)
Dana Delany, Debi Mazar
A Beautiful Soul (2012)
Deitrick Haddon, Lesley-Ann Brandt
See all results for "a beauyt" »
IMDbPro
American Hustle
Trailer #1
Breaking Bad
"Say My Name"
Machete Kills
Trailer #2
See featured HD Trailers »


Google
how to
how to tie a tie
how to take a screenshot on a mac
how to get rid of ants
how to hard boil eggs
Press Enter to search.


AT&T
4:33
New message
Enter recipient
The conversation will appear here.
This is a proj
Send
proj
project
projects

Problem 1. (Autocomplete Term)

Implement an immutable comparable data type called Term that represents an autocomplete

term: a string query and an associated real-valued weight. You must implement the following API, which supports comparing

terms by three different orders: lexicographic order by query; in descending order by weight; and lexicographic order by query

but using only the first r characters. The last order may seem a bit odd, but you will use it in Problem 3 to find all terms

that start with a given prefix (of length r).

Term(String query)	constructs a term given the associated query string, having weight 0
Term(String query, long weight)	constructs a term given the associated query string and weight
String toString()	returns a string representation of this term
int compareTo(Term that)	returns a comparison of this term and other by query
static Comparator<Term> byReverseWeightOrder()	returns a comparator for comparing two terms in reverse order of their weights
static Comparator<Term> byPrefixOrder(int r)	returns a comparator for comparing two terms by their prefixes of length r

Instance Variables

String query

Long weight

Constructor(s)

2 cases - making a new Term by just passing a query, or passing a query and a weight

Throw appropriate errors depending on the constructor and assign the appropriate starting values also depending on the constructor

ToString - Print Weight then Query Separated by a Tab

CompareTo(Term other) - Return a negative, zero, or positive integer based on whether this.query is less than, equal to, or greater than Other.query. (This can be done in a single line, but other implementations are okay - just more work for you)

static Comparator<Term> byReverseWeightOrder()/byPrefixOrder(int r)

Return object of type ReverseWeightOrder/PrefixOrder

(Kind of like in the exercises)

ReverseWeightOrder

int compare(Term v, Term w)

∗ Return a negative, zero, or positive integer based on whether v.weight is less than, equal to, or greater than

w.weight.

Prefix Order

Instance variable:

∗ Prefix length, int r.

– PrefixOrder(int r)

∗ Initialize instance variable appropriately.

– int compare(Term v, Term w)

∗ Return a negative, zero, or positive integer based on whether a is less than, equal to, or greater than b, where a is a substring of v of length min(r, v.query.length()) and b is a substring of w of length min(r, w.query.length()).

How the comparators are used

Used as a parameter in

```
Arrays.sort(terms , Term. byReverseWeightOrder ());
```

Problem 2. (Binary Search Deluxe)

When binary searching a sorted array that contains more than one key equal to the

search key, the client may want to know the index of either the first or the last such key. Accordingly, implement a library

called BinarySearchDeluxe with the following API:

static int firstIndexOf(Key[] a, Key key, Comparator<Key> c)

returns the index of the first key in a that equals the search key, or -1, according to the order induced by the comparator c

static int lastIndexOf(Key[] a, Key key, Comparator<Key> c)

returns the index of the last key in a that equals the search key, or-1, according to the order induced by the comparator c

Each method should should run in time T(n) ~ log n, where n is the length of the array a

*Gonna especially pay attention to this during grading for the Code + Efficiency section static int firstIndexOf(Key[] a, Key key, Comparator<Key> c)

– Modify the standard binary search such that when a[mid] matches key, instead of returning mid, remember it in, say

index (initialized to -1), and adjust hi appropriately.

– Return index

static int lastIndexOf(Key[] a, Key key, Comparator<Key> c) can be implemented similarly

Binary Search

- Start with full array, look at the middle
- Compare the middle element to the element you are searching for
- If your element is less than the middle
  - Move the high point to right before the middle
  - Find the middle of that new section
  - Rinse and repeat
- Same as above but opposite

Problem 3. (Autocomplete)

In this part, you will implement a data type that provides autocomplete functionality for a

given set of string and weights, using Term and BinarySearchDeluxe. To do so, sort the terms in lexicographic order; use binary

search to find the set of terms that start with a given prefix; and sort the matching terms in descending order by weight.

Organize your program by creating an immutable data type called Autocomplete with the following API

Autocomplete(Term[] terms)	constructs an autocomplete data structure from an array of terms
Term[] allMatches(String prefix)	returns all terms that start with prefix, in descending order of their weights
int numberOfMatches(String prefix)	returns the number of terms that start with prefix

The constructor should run in time T(n) ~ n log n, where n is the number of terms.

• The allMatches() method should run in time T(n) ~ log n + m log m, where m is the number of matching terms.

• The numberOfMatches() method should run in time T(n) ~ log n

Instance variables

Array of terms, Term[] terms

Autocomplete(Term[] terms

Initialize this.terms to a defensive copy (ie, a fresh copy and not an alias) of. terms

– Sort this.terms in lexicographic order

(You made a defensive copy in the last project when creating the copy of the q so you could shuffle it)

Term[] allMatches(String prefix)

Find the index i of the first term in terms that starts with prefix.

– Find the number of terms (say n) in terms that start with prefix.

– Construct an array matches containing n elements from terms, starting at. index i

– Sort matches in reverse order of weight and return the sorted array.

Hint* use one of the comparators you made in the last problem

int numberOfMatches(String prefix

– Find the indices i and j of the first and last term in terms that start with prefix.

– Using the indices, compute the number of terms that start with prefix, and return that value.

https://www.cs.usfca.edu/~galles/visualization/Search.html

Additional Resources