Project 1

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1. Linear Hashing (lazy delete)
   1. Theoretical predictions (from slides)

Average search time is constant, but it depends on load factor α. Efficiency of linear hashing degrades badly when α gets close to 1.

Expected time is for successful search, while for unsuccessful search.

Typical worst case search time is log n.

* 1. Description of algorithm
     1. Constructor

*Allocating an ArrayList with size of capacity of the hash table. Each element in the ArrayList is a Pair(key, value).*

* + 1. Hashing function

*Key % capacity*

* + 1. Set(key,value):

*Index = hashing(key)*

*Count = 0*

*While count < capacity AND element at index is not null AND key of element at index is not null:*

*Index = (index + 1) % capacity*

*Count++*

*If count is not capacity:*

*Put (key,value) at index*

* + 1. Search(key):

*Index = hashing(key)*

*Count = 0*

*While count < capacity AND list at index is not null AND key of element at index is not key:*

*Index = (index + 1) % capacity*

*Count++*

*If count < capacity AND element at index is not null:*

*Result = value of element at index*

* + 1. Delete(key)

*Index = hashing(key)*

*Count = 0*

*While count < capacity AND element at index is not null AND (key of element at index is null OR key of element at index is not key):*

*Index = (index + 1) % capacity*

*Count++*

*If count not equals capacity AND element of index is not null:*

*Set key of element at index to null*

* 1. Test results

1. Chained Hashing
   1. Theoretical predictions (from slides)

time/operation = O(1 + length(H[h(k)])

E[time/operation] = O(1 + α)

Typical worst case search time is

* 1. Description of algorithm
     1. Constructor

*Allocating an ArrayList with size of the capacity of hash table. Each element of the ArrayList is a LinkedList. Eech element of the LinkedList is a Pair(key, value).*

* + 1. Hashing function

*Key % capacity*

* + 1. Set

*Index = hashing(key)*

*If element at index is null:*

*New a LinkedList*

*Add a Pair(key, value) into the LinkedList*

*Put the LinkedList at index*

*Else:*

*Add the Pair(key, value) to the LinkedList at index*

* + 1. Search

*Index = hashing(key)*

*If element at index is not null:*

*For pair in the LinkedList:*

*If key of the pair equals key:*

*Return the pair*

* + 1. Delete

*Index = hashing(key)*

*If element at index is not null:*

*For pair in the LinkedList:*

*If key of the pair equals key:*

*delete the pair*

* 1. Test results

1. Cuckoo Hashing
   1. Theoretical predictions (from slides)

Guaranteed O(1) search

The expected time for the sequence of operations is O(n)

* 1. Description of algorithm
     1. Constructor

*Allocating two ArrayList with size of capacity of the hash table. Elemnt of an ArrayList is a Pair(key, value).*

* + 1. Hashing function

*One function: key % capacity*

*Another function: (key % capacity) % capapcity*

* + 1. findPlace(toPutPair) function

*t = 0*

*count = 0*

*index = hashing(t, key of toPutPair)*

*while element of ArrayList t at index is not null AND count < capacity:*

*if key of element of ArrayList t at index equals key:*

*break*

*put toPutPair to current position*

*update toPutPair with Pair at current position*

*t = 1 – t*

*index = hashing(t, key of toPutPair)*

*count++*

*if count >= capacity:*

*return -1 (to resize) and toPutPair*

*else:*

*return position and toPutPair*

* + 1. resize(toPutPair)

*backupList = this.list*

*noConflict = true*

*do*

*noConflict = true*

*capacity \*= 2*

*allocate new ArrayList with double size*

*put Pair of oldList into new ArrayList, if conflict set nonConflict to false*

*put toPutPair into new ArrayList, if conflict set nonConflict to false*

*while noConflict is false*

* + 1. Set(key, value):

*findPlace(toPutPair)*

*if need resize:*

*resize*

*else:*

*put toPutPair to the empty slot of one of the ArrayLists*

* + 1. Search(key)

*Try to find the key at position (hashing result) in each ArrayList.*

*If found:*

*Return it*

*Else:*

*Return null*

* + 1. Delete(key)

*Try to find the key at position (hashing result) in each ArrayList.*

*If found:*

*Delete it*

* 1. Test results

1. Quadratic Hashing (lazy delete)
   1. Theoretical predictions (from slides)
   2. Reason for choosing it

Quadratic probing is better since it avoids the clustering problem of linear probing-Wikipedia

* 1. Description of algorithm
     1. Constructor

*Allocating an ArrayList with size of capacity of the hash table. Each element in the ArrayList is a Pair(key, value).*

* + 1. Hashing function

*Key % capacity*

* + 1. Set(key,value):

*Count = 1*

*hashVal = hashing(key)*

*Index = (hashVal + count \* count) % capacity*

*While count < capacity + 1 AND element at index is not null AND key of element at index is not null:*

*Index = (hashVal + count \* count) % capacity*

*Count++*

*If count < capacity + 1:*

*Put (key,value) at index*

* + 1. Search(key):

*Count = 1*

*hashVal = hashing(key)*

*Index = (hashVal + count \* count) % capacity*

*While count < capacity + 1 AND element at index is not null AND (key of element at index is not key OR key of element at index not equals key):*

*Index = (hashVal + count \* count) % capacity*

*Count++*

*If count < capacity + 1 AND element at index is not null:*

*Return value of element at index*

* + 1. Delete

Count = 1

*hashVal = hashing(key)*

*Index = (hashVal + count \* count) % capacity*

*While count < capacity + 1 AND element at index is not null AND (key of element at index is null OR key of element at index not equals key):*

*Index = (hashVal + count \* count) % capacity*

*Count++*

*If count < capacity + 1 AND element of index is not null:*

*Set key of element at index to null*

* 1. Test results