Persistent Data Structure

Boyu Tian

ACM class
Shanghai Jiao Tong University

anshantby@163.com

July 15, 2014

Overview

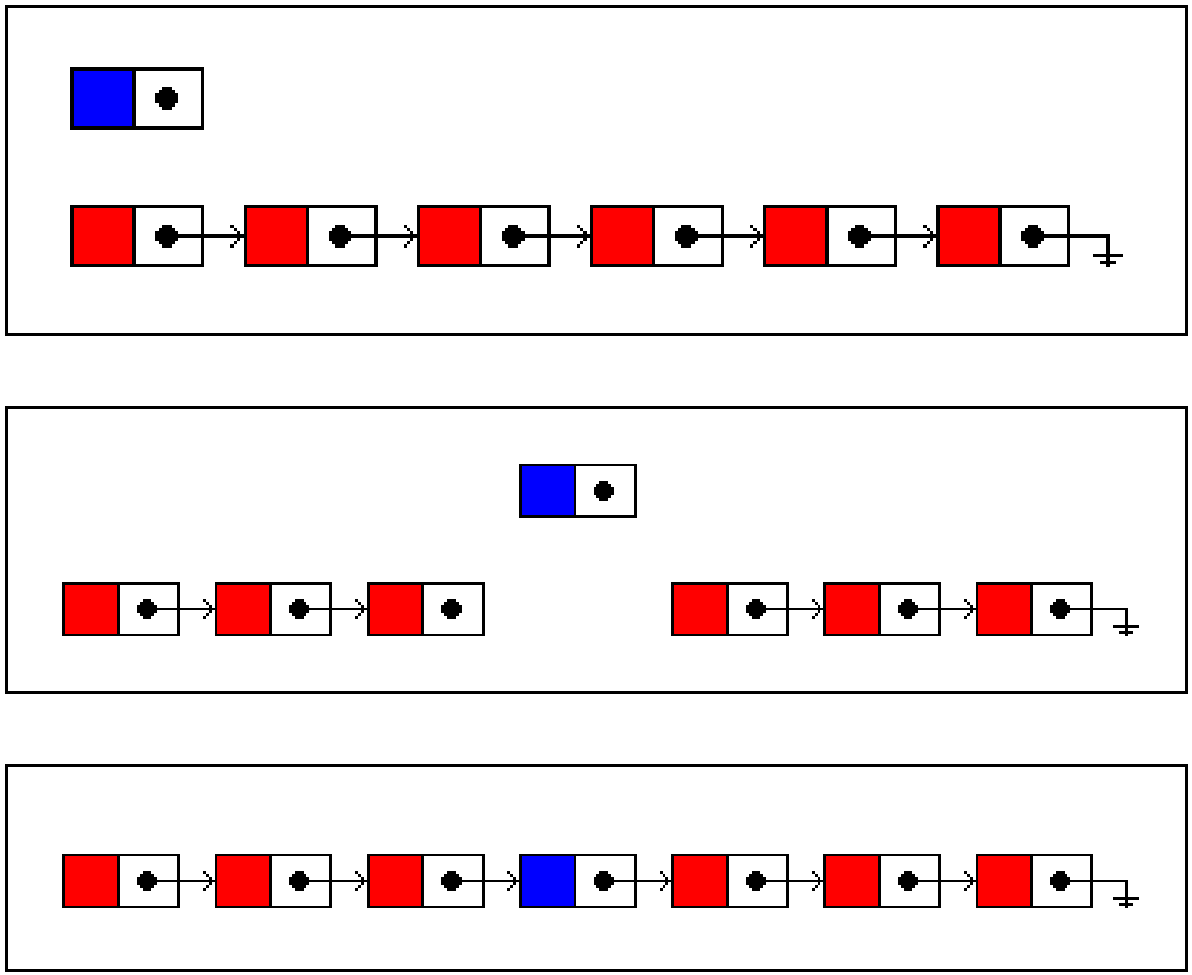
Persistent vs. Immutable

- An *immutable* data structure is one that, once created, cannot be modified
  - Immutable data structures can (usually) be copied, with modifications, to create a new version
  - The modified version takes up as much memory as the original version
- A *persistent* data structure is one that, when modified, retains both the old and the new version
  - Persistent data structures are effectively immutable, in that prior references to it do not see any change
  - Modifying a persistent data structure may copy *part* of the original, but the new version shares memory with the original

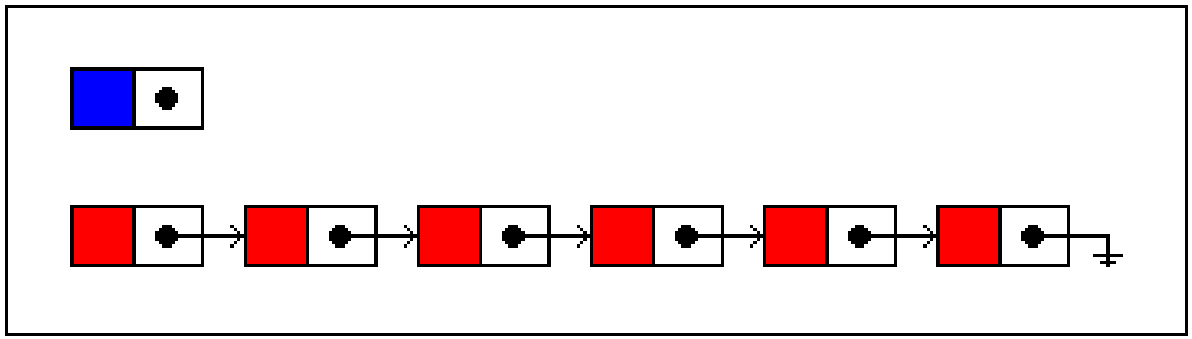
Why persistent data structures?

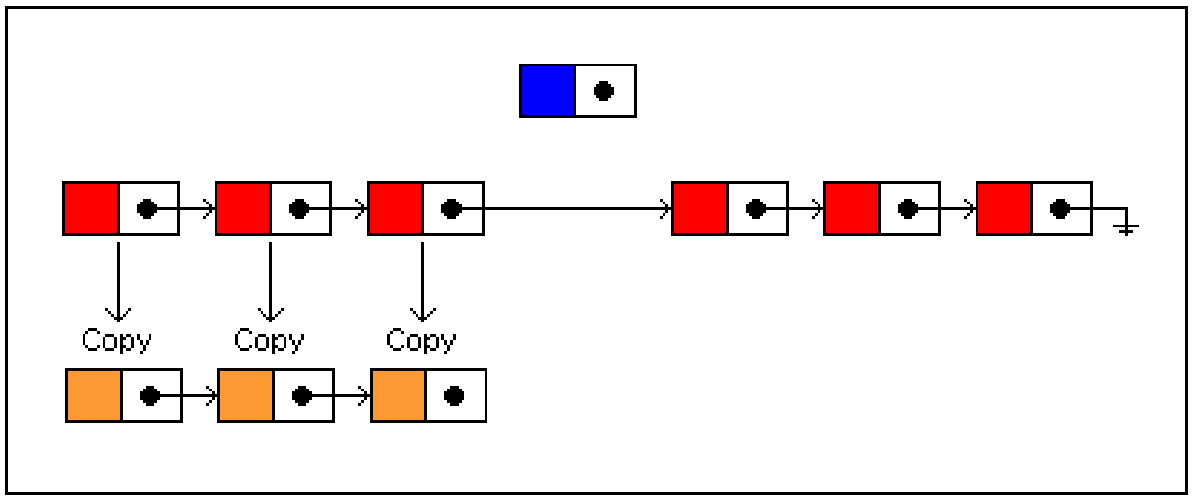
- Functional programming is based on the idea of immutable data, or persistent data, which is effectively immutable
- Synchronization is expensive, and immutable data structures don't need to be synchronized
- Copying large data structures is expensive and wastes space, but persistent data structures can use sophisticated structure sharing to reduce the cost on disk between program executions

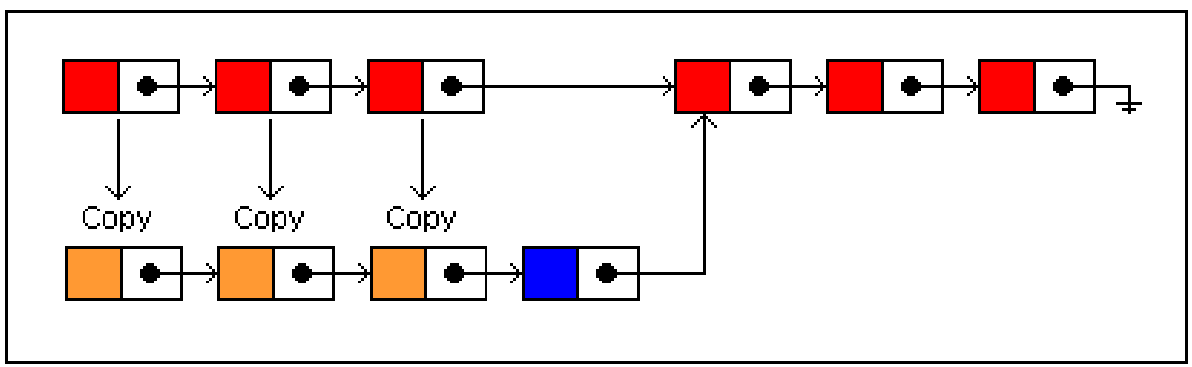
Singly Linked Lists



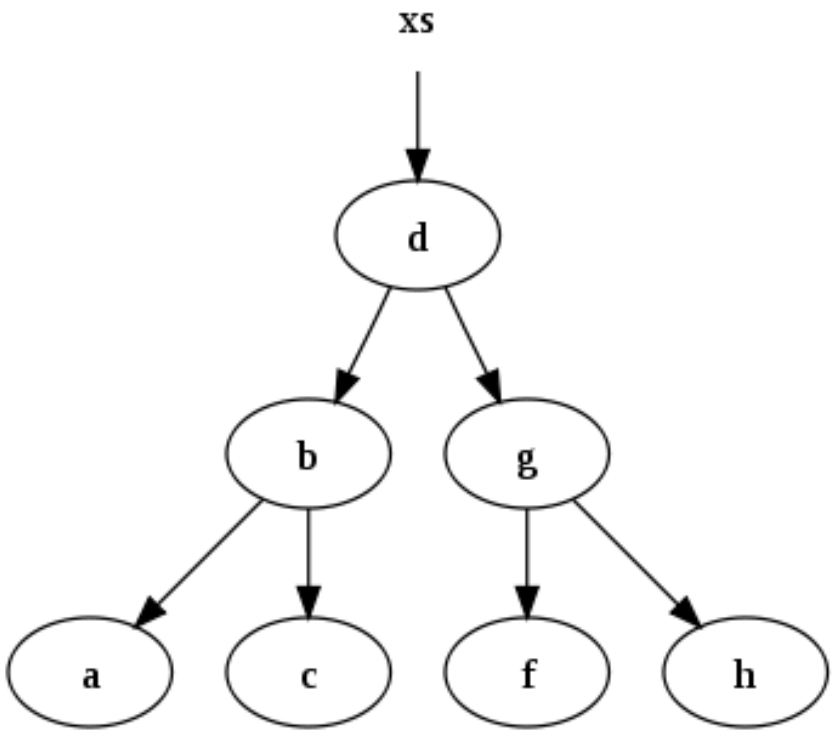
Persistent Singly Linked Lists



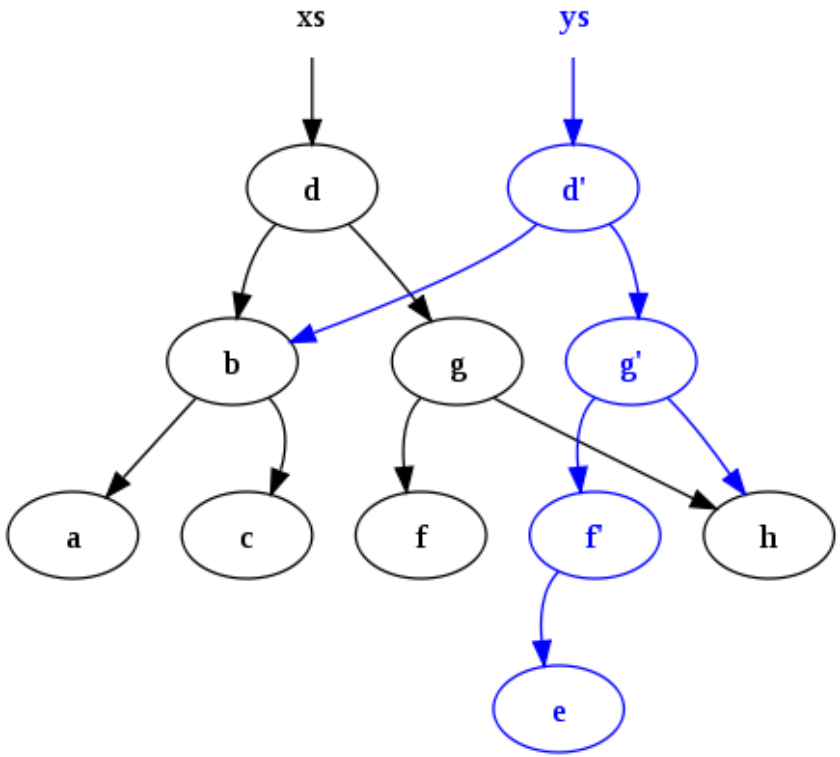




Persistent Binary Trees



Persistent Binary Trees



Persistent Treap

- merge(a,b)
- split(a,n)

merge(a,b)

- If key(a) $<$ key(b),
  change right(a) to merge(right(a),b)
- Otherwise,
  change left(b) to merge(a,left(b))

split(a,n)

- If cnt =size(left(a))$\geq$ n,
  Let $\{l, r\}$ =split(left(a),n)
  change left(a) to r and return $\{l, a\}$

- Otherwise, Let $\{l, r\}$ =split(right(a), $n - cnt - 1$)
  change right(a) to l and return $\{a, r\}$

Exercise

http://www.spoj.com/problems/MKTHNUM/
http://www.spoj.com/problems/COT/
http://codeforces.com/problemset/problem/191/E
http://uva.onlinejudge.org/index.php?option=com_onlinejudge&Itemid=8&page=show_problem&problem=3983
http://www.lydsy.com/JudgeOnline/problem.php?id=1901
http://www.lydsy.com/JudgeOnline/problem.php?id=3110
http://www.lydsy.com/JudgeOnline/problem.php?id=2670
http://builtinclz.abcz8.com/showart.php?id=2011/0711_editorprob

The End