cs140 – algorithms
prof. yi chen

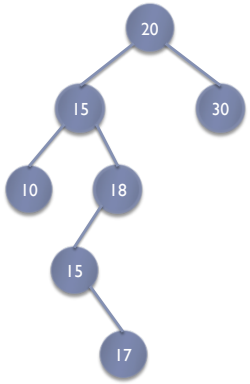
september 24, 2013

dynamic tables

- data structure
  - insert(T,x)
  - delete(T,x)
- implementation
  - array
  - If insert in a full array, double the size of the array, copy over, and insert
  - If delete takes array to some reduced size, contract array
- cost of insert?

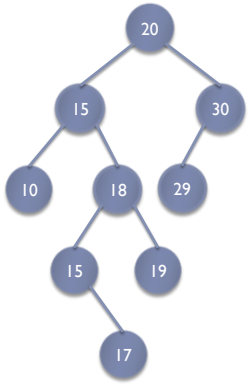
Binary search trees

- what is it?
- what operations?
  - search(T,k)
  - minimum(T)
  - maximum(T)
  - successor(T,x)
  - predecessor(T,x)
  - insert(T,x)
  - delete(T,x)



Binary search trees

- what is it?
- what operations?
  - search(T,k)
  - minimum(T)
  - maximum(T)
  - successor(T,x)
  - predecessor(T,x)
  - insert(T,x)
  - delete(T,x)



Balanced binary search trees

- Red-black tree
- Splay tree
- 2-3 trees
- AVL trees
- ... etc ...

Red-black trees

- each node:
  - color
  - key
  - left, right, parent
- tree maintains 5 properties
  1. every node is red or black
  2. root is black
  3. leaves (null pointers) are black
  4. if node is red, both children are black
  5. for every node, all paths from node to descendant leaves contain the same number of black nodes.

Red-black trees

1. every node is red or black
2. root is black
3. leaves (null pointers) are black
4. if node is red, both children are black
5. for every node, all paths from node to descendant leaves contain the same number of black nodes.