CSE 373

MARCH 31 – PRIORITY QUEUES AND THE HEAP
ASSORTED MINUTIAE

• Weiss readings
  • On course website

• HW1 is out (patch out tonight)
  • Eclipse users will get some help
  • Test 5 fix

• 143 review
  • Monday, time/location TBA
TODAY’S LECTURE

• Priority Queue ADT
• Heap DS
  • Heap Property
  • Completeness property
• Implementation
REVIEW FROM LAST WEEK

• Priority Queue
  • Data enqueued with a priority
  • Lower priority data dequeue first
  • Maintain queue principle?

• Implementations?
  • Array and Linked List both have serious flaws.
PRIORITY QUEUE

• Priority queue implementations?
  • Binary search tree?
    • Faster insert
    • Find? Always deleting the smallest (left-most) element
  • Maintaining FIFO?
  • Changing priority?
PRIORITY QUEUE

• Want the speed of trees (but not BST)
• Priority Queue has unique demands
• Other types of trees?
• Review BST first
PROPERTIES (BST)

- Tree (Binary)
  - Root
  - (Two) Children
  - No cycles

- Search
  - Comparable data
  - Left child data < parent data
  - Smallest child is at the left most node
PROPERTIES (BST)

• Binary tree may be useful
• Search property doesn’t help
  • Always deleting min
  • Put min on top!
HEAP-ORDER PROPERTY

• Still a binary tree

• Instead of search (left < parent), parent should be less than children

• How to implement?

• Insert and delete are different than BST
HEAP-ORDER PROPERTY

• Still a binary tree
• Instead of search (left < parent), parent should be less than children
• How to implement?
• Insert and delete are different than BST
HEAP EXAMPLE

- Only looking at priorities
- Insert something priority 4
• Now insert priority 6?
• Should come after 4, but no preference right over left?
• Solution: fill the tree from top to bottom left to right.
HEAP EXAMPLE

Now insert 2.
HEAP EXAMPLE

Now insert 2.
HEAP EXAMPLE

Is this the only solution that maintains the heap property?

Is any one better than the other?
Filling left to right and top to bottom is another property - completeness
HEAPS

- Heap property (parents < children)
- Complete tree property (left to right, bottom to top)
- How does this help?
  - Array implementation
HEAPS

- Insert into array from left to right
- For any parent at index $i$, children at $2i+1$ and $2i+2$
HEAPS

• How to maintain heap property then?
  • Parent must be higher priority than children
• Two functions – percolate up and percolate down
  • DRAWN NOTES HERE
HEAPS

• Does the heap work for the Priority Queue problem?
  • FIFO preservation?

No. Only comparisons are priority.
NEXT WEEK

• Look more closely at heap functions and runtimes
• Beginning of algorithm analysis