Lecture 16: Trees in Arrays & Priority Queues

Fall 2016

Kim Bruce & Peter Mawhorter

This Week

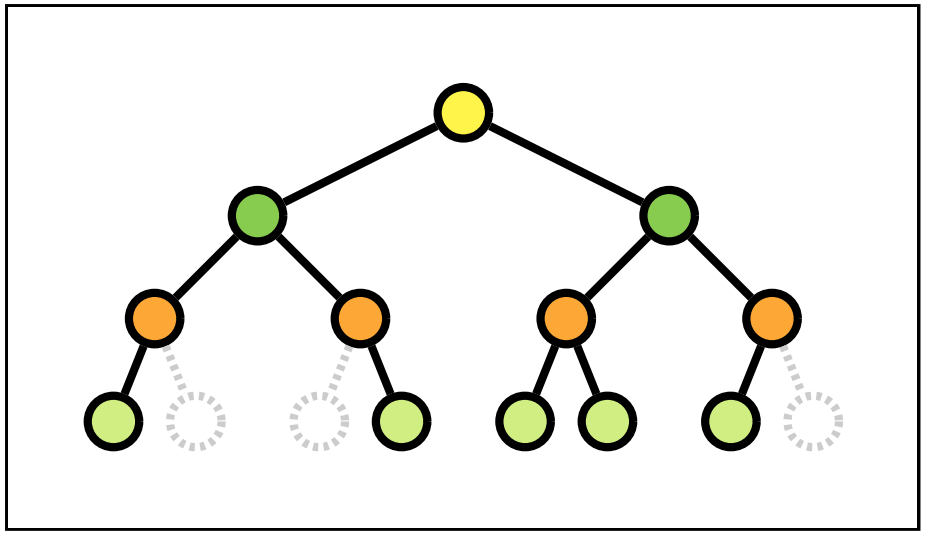
- No quiz today.
- Assignment: Calculator
  - Postfix calculator
  - Start with simplified version that requires "enter" before each operation

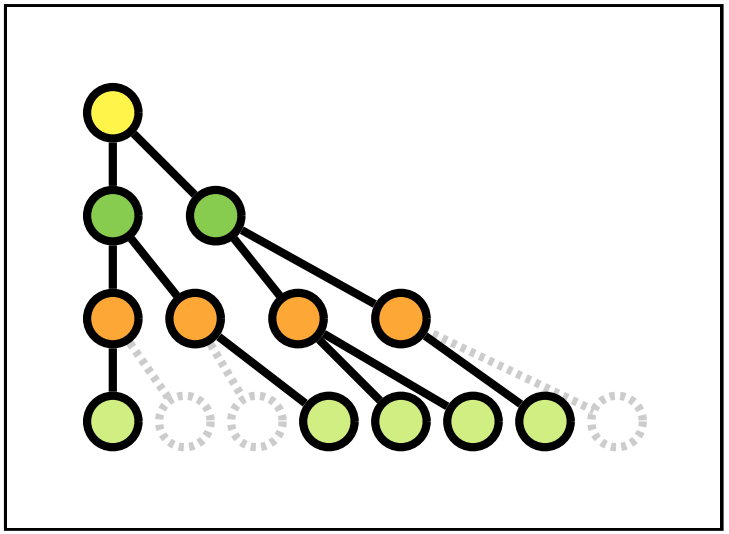
The Midterm

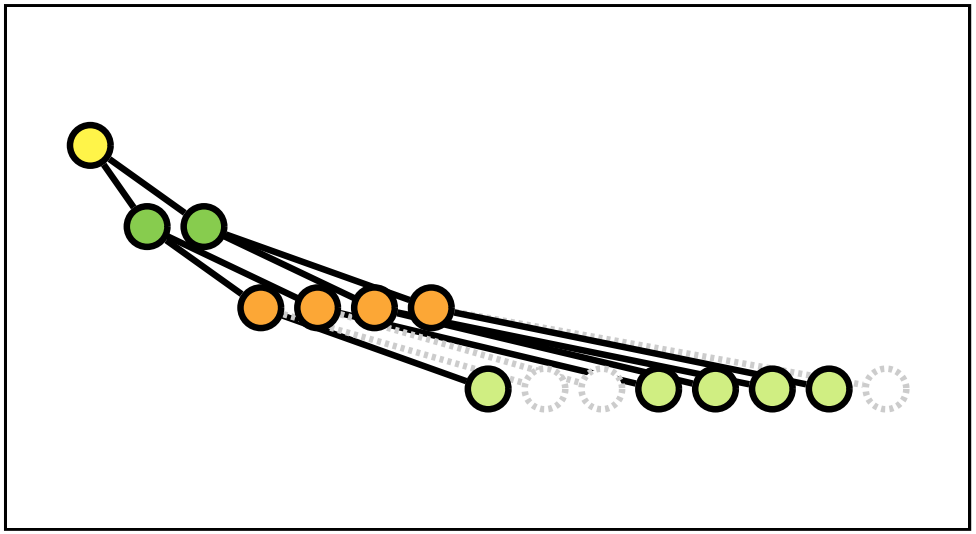
- Will be graded by next week (perhaps Wednesday)
- There's a second midterm

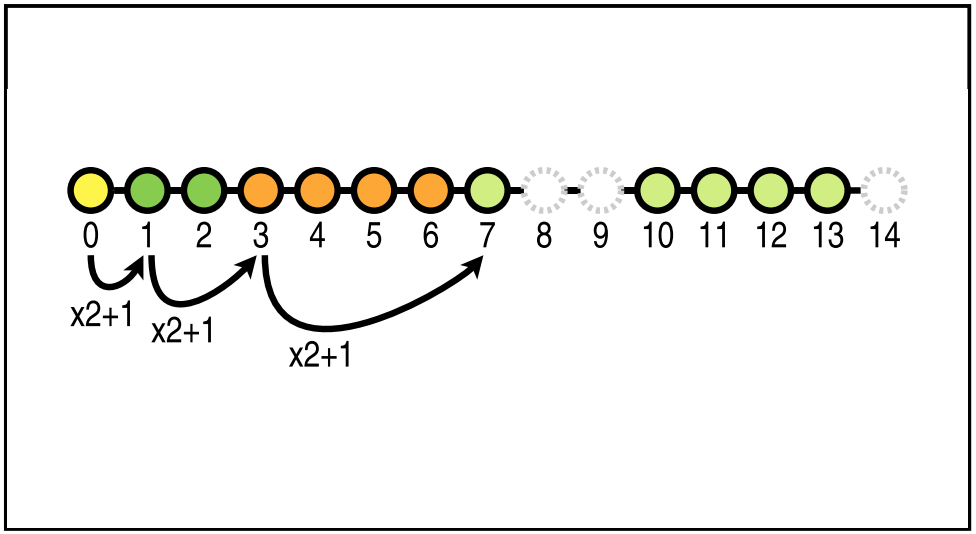
How can they Fit?

- How do you fit a 2D data structure into a 1D array?
  - How did `RowOrderedPosn` do it?
  - Is there an index formula that will work for a tree?

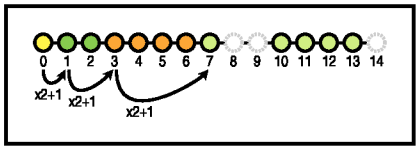







0 1 2 3 4 5 6 7 8 9 10 11 12 13 14
x2+1
x2+1
x2+1

Indices



- `data[0..n-1]` can hold data for tree of height $\log n$
  - left child of i goes at $2i+1$, right child at $2i+2$
  - parent is at $(i-1)/2$

Efficiency

- We need 2^{h-1} slots even if we only store $O(h)$ nodes
  - Bad for sticks and skinny trees
  - Good for full and well-balanced trees (topiary)
- A *complete* tree is full at every layer except the last, where empty spots are all on the right

`PriorityQueue`

```
public interface PriorityQueue<E extends Comparable<E>>
{
  /**
   * @pre !isEmpty()
   * @return The minimum value in the queue.
   */
  public E remove();
  public E getFirst();
  public void add(E value);
  public boolean isEmpty();
  public int size();
  public void clear();
}
```

First Pass

- Use a regular queue to hold the data
- Search for the min every time we call `remove`
  - `remove` is $O(n)$

Second Pass

- Use a regular queue to hold the data
- Every time we `insert`, put it in the right place
  - `insert` is now $O(n)$

Hmmmmm

- What subject have we talked about without a practical use-case?
- Why are we discussing two unrelated topics today?

For Next Time

Heaps