#13: Trees
February 14, 2018 · Wade Fagen-Ulmschneider

## Iterator Design:
[Monday’s Lecture]: To implement an iterator, the implementing class must have two member functions:
- ::begin(), returns an iterator at the first element
- ::end(), returns an iterator one past the end

```
template <class QE>
class Queue {
    public:
        class QueueIterator : public std::iterator<std::forward_iterator_tag, QE> {
            public:
                QueueIterator(unsigned index);
                QueueIterator& operator++();
                bool operator==(const QueueIterator &other);
                bool operator!=(const QueueIterator &other);
                QE& operator*();
                QE* operator->();
            private:
                int location_;
            }
        }
    private:
        QE* arr_; unsigned capacity_, count_, entry_, exit_;
};
```

How does the `Queue` and the `QueueIterator` interact?

**Two big takeaways:**

1. 
2. 

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**Trees!**
“The most important non-linear data structure in computer science.”
- David Knuth, The Art of Programming, Vol. 1

- We will primarily talk about **binary trees**
- What’s the longest “word” you can make using the **vertex** labels in the tree (repeats allowed)?
- Find an **edge** that is not on the longest **path** in the tree. Give that edge a reasonable name.
- One of the vertices is called the **root** of the tree. Which one?
- Make a “word” containing the names of the vertices that have a **parent** but no **sibling**.
- How many parents does each vertex have?
- Which vertex has the fewest **children**?
- Which vertex has the most **ancestors**?
- Which vertex has the most **descendants**?
- List all the vertices in b’s left **subtree**.
- List all the **leaves** in the tree.
**Definition: Binary Tree**

A binary tree T is either:

**Tree Property: Full**

**Tree Property: Tree Height**

**Tree Property: Perfect**

**Tree Property: Complete**

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**CS 225 – Things To Be Doing:**

1. Programming Exam A is ongoing
2. MP3 has been released; extra credit deadline is Monday!
3. lab_quacks in lab this week
4. Daily POTDs