CMSC 132: OBJECT-ORIENTED PROGRAMMING II

Polymorphic Lists & Trees

Polymorphic Binary Search Trees

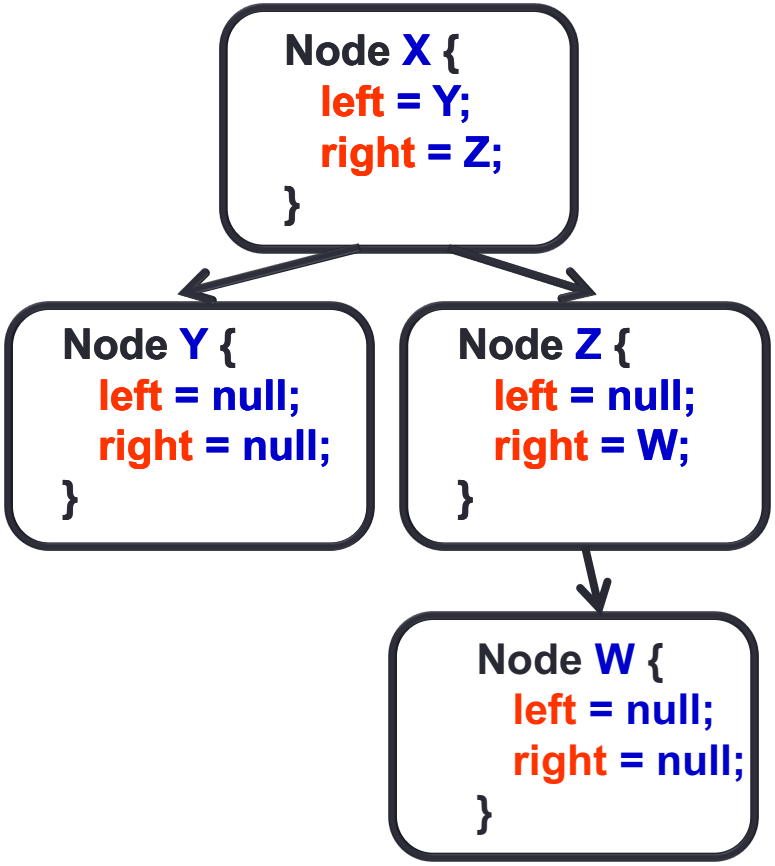
- Second approach to implement BST
- What do we mean by polymorphic?
- Implement two subtypes of Tree
  - EmptyTree
  - NonEmptyTree
- Use EmptyTree to represent the empty tree
  - Rather than null
- Invoke methods on tree nodes
  - Without checking for null (IMPORTANT!)

Polymorphic Binary Tree Implementation

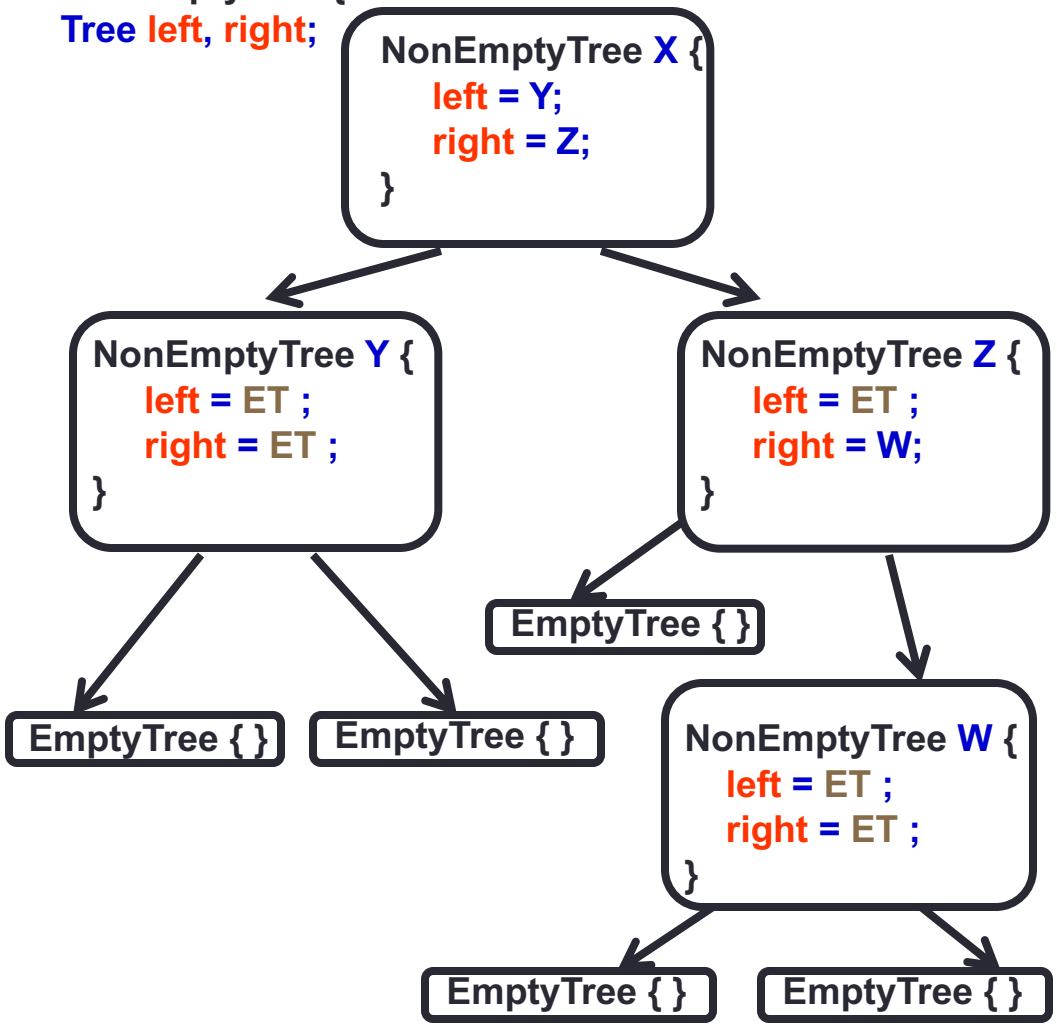
```
Interface Tree {
    Tree insert ( Value data1 ) { … }
}
Class EmptyTree implements Tree {
    Tree insert ( Value data1 ) { … }
}
Class NonEmptyTree implements Tree {
    Value data;
    Tree left, right; // Either Empty or NonEmpty
    Tree insert ( Value data1 ) { … }
}
```

Standard vs. Polymorphic Binary Tree

```
Class Node {
        Node left, right;
}
```




```
Class EmptyTree {}
Class NonEmptyTree {
        Tree left, right;
}
```



Singleton Design Pattern

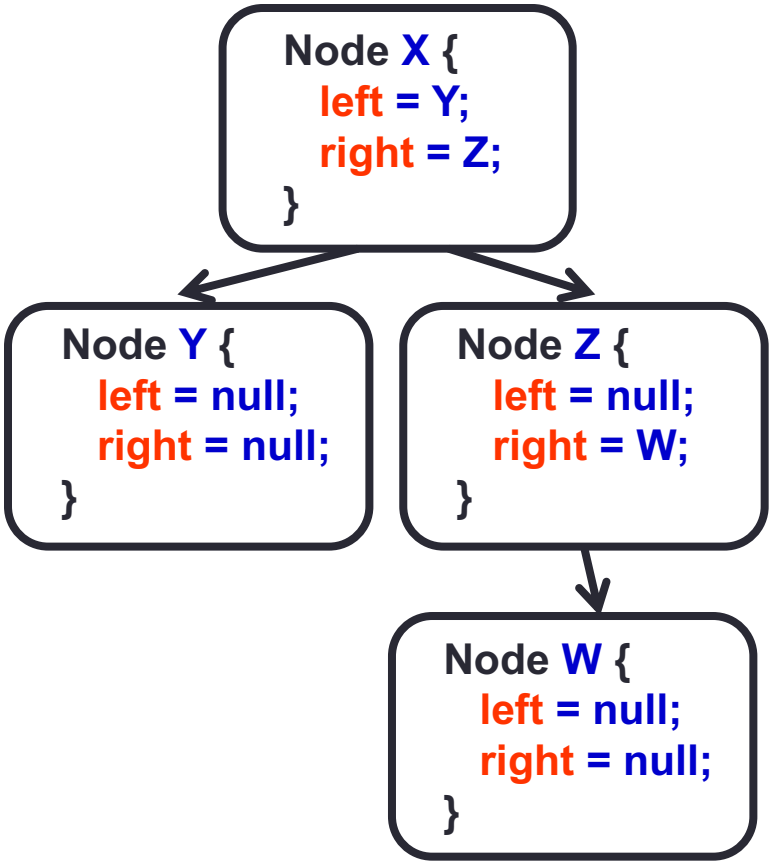
- Definition
  - One instance of a class or value accessible globally
- Where to use & benefits
  - Ensure unique instance by defining class final
  - Access to the instance only via methods provided
- EmptyTree class will be a singleton class

Singleton Example

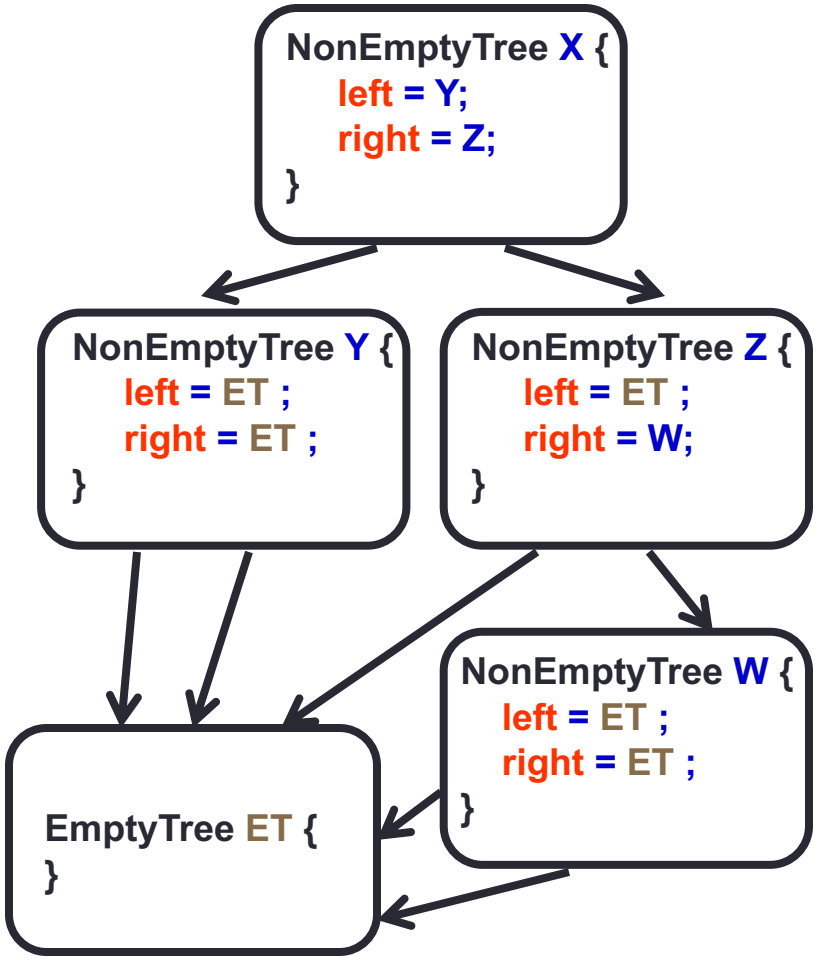
```
public final class MySingleton {
  // declare the unique instance of the class
  private static MySingleton uniq = new MySingleton();
  // private constructor only accessed from this class
  private MySingleton() { … }
  // return reference to unique instance of class
  public static MySingleton getInstance() {
      return uniq;
  }
}
```

Using Singleton EmptyTree

```
Class Node {
        Node left, right;
}
```




```
Class EmptyTree {}
Class NonEmptyTree {
        Tree left, right;
}
```



Polymorphic List Implementation

- Let's see a polymorphic list implementation
- See code distribution: LecturePolymorphicListCode.zip

Polymorphic Tree

- Let’s see the different operations for a polymorphic tree