Data Structures I: N-ary trees

Mauricio Toro
Department of Informatics and Systems
Universidad EAFIT

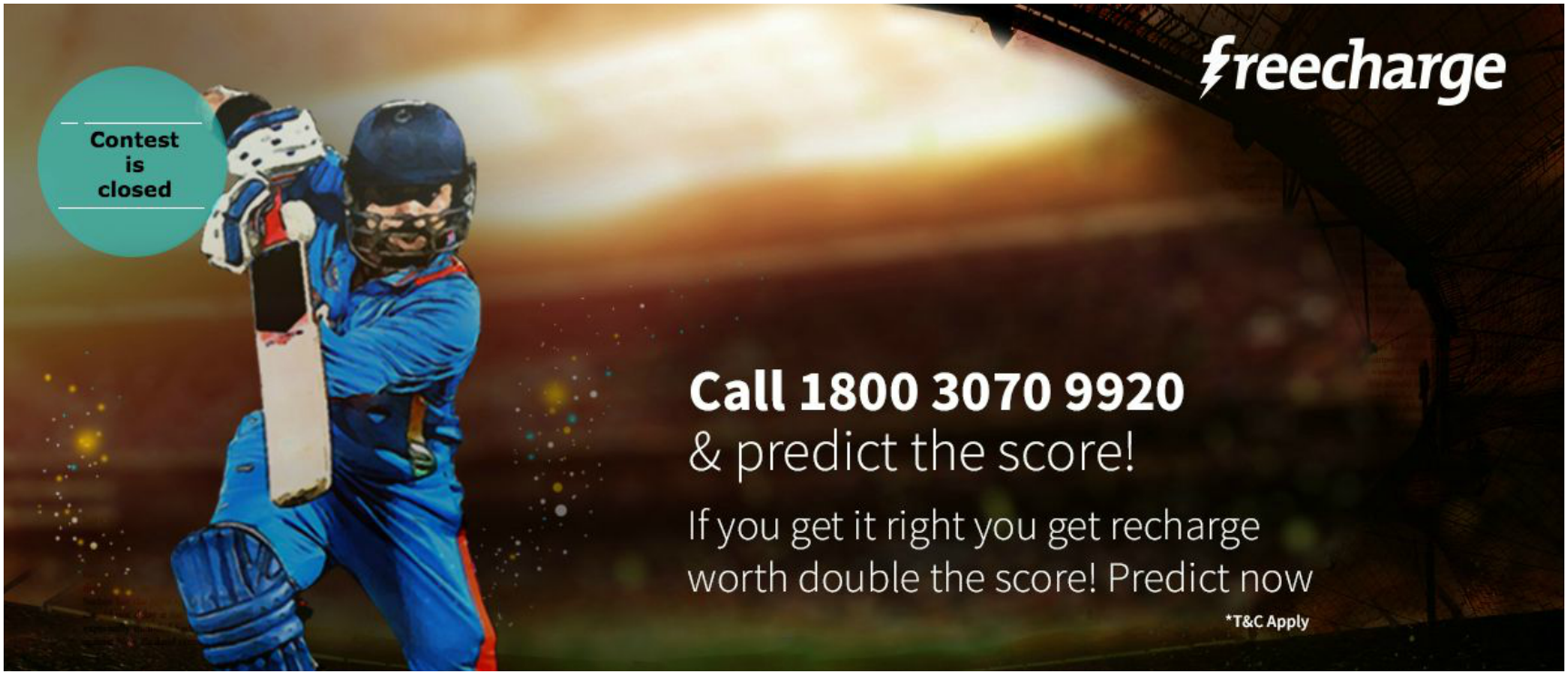
Cocktail of the day: Pisco Sour

Disclaimer: Keep alcohol out of the hands of minors.

Cocktail of the day: Pisco Sour

- 45 ml of Pisco
- 30 ml of lime juice
- 20 ml of simple syrup
- 1 egg white

Score Predictors use trees



https://en.wikipedia.org/wiki/WASP_%28cricket_calculation_tool%29

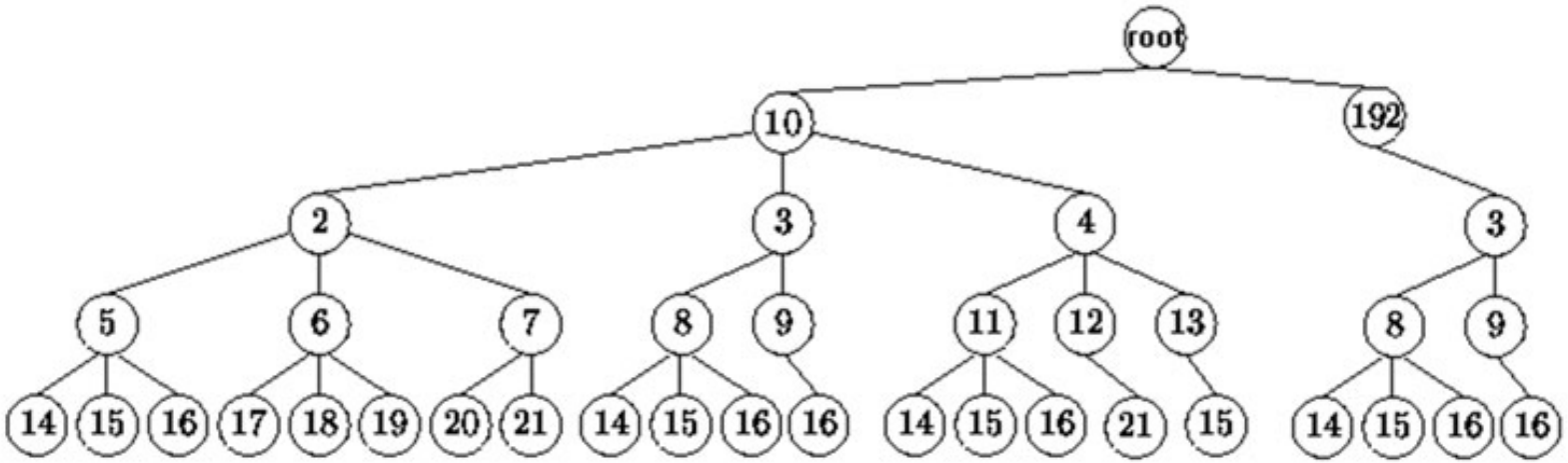
Binary tree

A binary tree is a tree data structure in which each node has at most two children, which are referred to as the left child and the right child.

1. Applications
2. Implementation
3. Some Algorithms
   - Number of elements
   - Maximum Height
   - Tree traversal
     - https://www.youtube.com/watch?v=gm8DUJJhmY4
     - https://www.youtube.com/watch?v=9RHO6jU--GU

N-ary tree

An N-ary tree is a rooted tree in which each node has at most n children.



Node of an N-ary Tree

```
import java.util.ArrayList;
public class Node {
 public final ArrayList<Node> children;
 public final int data;
 public Node(int d){
    data = d;
    children = new ArrayList<Node>();
 }
}
```

N-ary tree

```
public class NaryTree {
  Node root;
  public NaryTree() {
     root = null;
  }
}
```

Number of elements of a Binary Tree

```
public class BinaryTree {
  private int elementsAUX(Node node) {
    if (node == null)
        return 0;
    else
        return elementsAUX(node.left)+
               elementsAUX(node.right)+1;
  }
  public int elements() {
     return elementsAUX(root);
  }
}
```

Number of elements of a Ternary Tree

```
public class TernaryTree {
  private int elementsAUX(Node node) {
    if (node == null)
        return 0;
    else
        return elementsAUX(node.left)+
               elementsAUX(node.center)+
               elementsAUX(node.right)+1;
  }
  public int elements() {
     return elementsAUX(root);
  }
}
```

Number of elements of a N-ary Tree

```
public class NaryTree {
  private int elementsAUX(Node node) {
        int cont = 0;
        if (node != null)
     for (int i = 0;
          i < node.children.size(); i++) {
        cont++;
        cont += elementsAUX(
                        node.children.get(i)); }
    return cont;  }
  public int elements() {
     return elementsAUX(root);
} }
```

Maximum Height of a N-ary Tree

```
public class NaryTree {
  private int maxHAUX(Node node) {
      int max = 0;
      if (node != null)
        for (int i=0;
                 i<node.children.size(); i++)
          max = Math.max(
                 maxHAUX(node.children.get(i))+
                 max);
      return max;
  }
  public int maxHeight() {
      return maxHAUX(root); }}
```

Depth-first search

```
public class NaryTree {
  private boolean dfsAUX(Node node, int x){
        boolean resp = false;
    if (node != null) for (int i = 0;
            i < node.children.size(); i++) {
          resp = node.data == x ||
            dfsAUX(node.children.get(i),x);
          if (resp) return true;
      }
    return resp;
  }
  public boolean dfs(int x) {
   return dfsAUX(root, x); }}
```

Depth-first traversal

```
public class NaryTree {
  private void printAUX(Node node) {
    if (node != null) {
        System.out.println(node.data);
        for (int i = 0;
             i < node.children.size(); i++)
          printAUX(node.children.get(i));
    }
  }
  public void print() {
   printAUX(root);
  }
}
```

# Breadth-first traversal
import java.util.LinkedList;

```
public class NaryTree {
  private void printByLevels() {
   LinkedList<Node> queue = new LinkedList();
   if (root != null)
      queue.add(root);
   while (queue.size() != 0) {
        Node node = queue.pop();
        System.out.println(node.data);
        for (int i = 0;
             i < node.children.size(); i++)
          if (node.children.get(i) != null)
            queue.add(node.children.get(i));
```

Applications of DFS and BFS

One application is path finding!
`http://kevanahlquist.com/osm_pathfinding/`
Path finding is used in Google Maps and Videogames.

References

- Please learn how to reference images, trademarks, videos and fragments of code.
- Avoid plagiarism

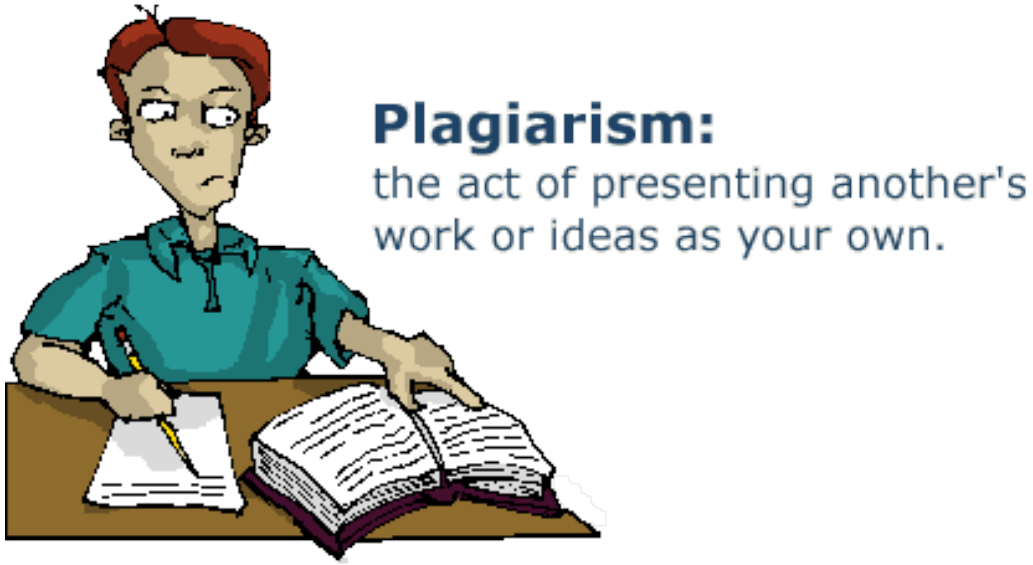


Figure: Figure about plagiarism, University of Malta [Uni09]

References I

University of Malta.

Plagarism — The act of presenting another's work or ideas as your own, 2009.

[Online; accessed 29-November-2013].

Further reading

- N-ary trees
  - https://en.wikipedia.org/wiki/K-ary_tree