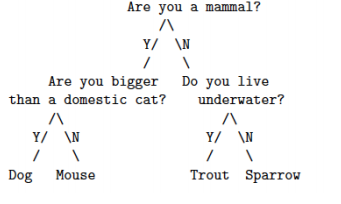
# LAB1: Implementation of Binary Tree

# Problem Definition

Animal Guessing game is a simple game in which the player thinks of an animal and the computer tries to guess which animal the player is imagining by asking the questions which can be answered in Yes/No. For example, suppose dog is the animal that the user is thinking of. The computer will then generate the question at the root node “Are you a mammal?" as the first question. The user has to press 'y' or 'n' (1 or 0) as the response. Based on the response the computer will generate the second question. The game continues until the leaf node is reached. At the leaf node the computer will generate the guess (dog, mouse, trout or sparrow in the example considered). The tree that is considered in this game is as follows:



For example:

Computer: Are you a mammal?

Player: Yes

Computer: Are you bigger than a domestic cat?

Player: No

The animal that is mammal and smaller than a cat is Mouse (as stored in your tree). Therefore, the computer should give:

The animal you are thinking of is: Mouse.

# Methodology

Binary tree has been implemented to store the questions and animals name. A binary tree is a data structure where a node has at most two children, usually referred to as the “left" child and the “right" child. The class of node has been made in JAVA programming language which is similar to node structure.

**public class** Node {  
 Node **leftChild**,**rightChild**;  
 Integer **id**;  
 String **question**;  
 **public** Node(String question, **int** id) {  
 **this**.**question** = question;  
 **this**.**id** = id;  
 }  
}

And the root node is made with a root question. Then, the left and right node are added.

//root node

**public** Node addRootNode(String question,**int** id)  
{  
 Node root=**new** Node(question,id);  
 **return** root;  
}

//creation of left node

**public void** addLeftNode(Node root, **int** parentId, **int** id, String question) {  
 **if** (root.**id** == parentId) {  
 Node newNode = **new** Node(question, id);  
 root.**leftChild** = newNode;  
 **return**;  
 }  
 **else** {  
 **if** (root.**leftChild** != **null**) {  
 addLeftNode(root.**leftChild**, parentId, id, question);  
 }  
 **if** (root.**rightChild** != **null**) {  
 addLeftNode(root.**rightChild**, parentId, id, question);  
 }  
  
 }  
}

//creation of right node

**public void** addRightNode(Node root, **int** parentId, **int** id, String question) {  
 **if** (root.**id** == parentId) {  
 root.**rightChild** = **new** Node(question, id);  
 **return**;  
 } **else** {  
 **if** (root.**leftChild** != **null**) {  
 addRightNode(root.**leftChild**, parentId, id, question);  
 }  
 **if** (root.**rightChild** != **null**)  
 addRightNode(root.**rightChild**, parentId, id, question);  
 }  
  
}

Then the questions and the name of animals are inserted in the binary tree we created as follow:

**public static void** main(String[] args) {  
  
 GameImpletation addNode = **new** GameImpletation();  
 Node rootNode=addNode.addRootNode(**"Are you a mammal"**,0);*//Root node is created  
  
 //The nodes are added to the tree* addNode.addLeftNode(rootNode, 0, 1, **"Are you bigger than a cat?"**);  
 addNode.addLeftNode(rootNode, 1, 3, **"Dog"**);  
 addNode.addRightNode(rootNode, 1, 4, **"Mouse"**);  
  
 addNode.addRightNode(rootNode, 0, 2, **"Do you live underwater?"**);  
 addNode.addLeftNode(rootNode, 2, 5, **"Trout"**);  
 addNode.addRightNode(rootNode, 2, 6, **"Sparrow"**);  
  
 System.***out***.println(**"Press 1 for yes and 0 for No"**);  
 *startGame*(rootNode);*//rootnode is passed to startGame*}

The value is checked as follows:

**public static boolean** checkLeaf(Node node)  
{  
 **boolean** isLeaf=**false**;  
 **if**(node.**leftChild**==**null** && node.**rightChild**==**null**)  
 {  
 isLeaf=**true**;  
 }  
 **return** isLeaf;  
  
}

The game is then played as follows:

**public static void** startGame(Node node) {  
 *//This loop runs until break is initiated* **while** (**true**) {  
  
 Scanner input = **new** Scanner(System.***in***);  
 System.***out***.println(node.**question**);  
 **int** answer = input.nextInt();  
 **if** (answer == 1) {  
 node=node.**leftChild**;*//switch to left child* } **else if** (answer == 0) {  
 node=node.**rightChild**;*//switch to right child* } **else** {  
 System.***out***.println(**"Invalid entry"**);  
 }  
 **if**(*checkLeaf*(node) == **true**)*//the current node is leaf node* {  
 System.***out***.println(**"The animal guessed is:\t"**+node.**question**);  
 **break**;*//Exit the loop* }  
  
 }  
 }  
}

The outputs are as follows:

Press 1 for yes and 0 for No

Are you a mammal?

0

Do you live underwater?

1

The animal guessed is: Trout

Press 1 for yes and 0 for No

Are you a mammal?

1

Are you bigger than a cat?

1

The animal guessed is: Dog

# Analysis

This program changes its current node according to the answer given by player. For example:

In first example,

The question at root node is “Are you a mammal?” The answer by the player is 0. Then it moves to other node, i.e. right node where the node has question “Do you live underwater?” The player answered 1. Then it gives the answer at its left child and that is Trout.