ASSIGNMENT 8

**Name: Soham Makarand Limaye**

**Roll No: 222038**

**PRN: 22111058**

**Batch: B2**

**Aim:**Implement real time application of any advanced data structure like Tree, Graph, Files, Hashing, Symbol Table, Heaps etc

**Group Members:**

1. Atharva Gawas (Roll No: 222026)
2. Aman Kasat (Roll No: 222033)
3. Harshal Patil (Roll No: 222048)
4. Komal Patil (Roll No: 222049)
5. Ratnakar Patil (Roll No: 222050) **Problem Statement**:

Applications of Phylogenetic Trees

**Objective**:

* + Representing evolutionary relationships: Phylogenetic trees are a powerful tool for representing the evolutionary relationships among a

group of organisms. By organizing the organisms into a hierarchical structure, the tree can help to reveal patterns of evolutionary history and biodiversity.

* + Visualization and analysis: A phylogenetic tree can be used to

visualize and analyze complex biological data, such as DNA or

protein sequences. The tree can help to identify patterns of genetic variation and can be used to infer the evolutionary history of the sequences.

* + Comparing and classifying organisms: Phylogenetic trees can be used to compare and classify organisms based on their evolutionary relationships. This can be particularly useful in fields such as systematics, taxonomy, and biogeography.
  + Hypothesis testing: Phylogenetic trees can be used to test hypotheses about evolutionary relationships and to generate predictions about the evolutionary history of a group of organisms. This can help to refine our understanding of the processes that have shaped the diversity of life on Earth.
  + Overall, implementing phylogenetic trees as a data structure can help to organize and analyze biological data, reveal patterns of evolutionary history, and provide insights into the origins and relationships of organisms.

**Theory :**

Phylogenetic trees are graphical representations of the evolutionary relationships among a group of organisms. The branches of the tree represent the evolutionary lineage of the organisms, and the nodes indicate the point at which lineages diverged from a common ancestor. The length of the branches can be used to estimate the amount of time that has elapsed since the divergence of two lineages. Phylogenetic trees are based on the principle of common descent, which holds that all living organisms share a common ancestor. The process of evolution by natural selection leads to the diversification of life forms over time, resulting in the formation of new species, genera, families, and so on. By examining the similarities and differences among organisms, scientists can reconstruct the evolutionary history of life on Earth and construct phylogenetic trees to illustrate these relationships. Phylogenetic trees can be constructed using various methods, including molecular data (such as DNA or protein sequences), morphological characteristics, or a combination of both. These trees provide important insights into the origins and relationships of organisms, and they are widely used in fields such as evolutionary biology, systematics, and biogeography.

**Code :**

import java.util.ArrayList; import java.util.List;

class PhylogramNode { private String label; private double branchLength; // between node and its parent private PhylogramNode parent; private List<PhylogramNode> children;

public PhylogramNode(String label, double branchLength) { this.label = label; this.branchLength = branchLength; this.parent = null; this.children = new ArrayList<>();

}

public void setParent(PhylogramNode parent)

{ this.parent = parent;

}

public void addChild(PhylogramNode child) { child.setParent(this);

this.children.add(child);

}

public List<PhylogramNode> getChildren()

{ return this.children;

}

public PhylogramNode getParent()

{ return this.parent;

}

public double getBranchLength()

{ return this.branchLength;

}

public String getLabel()

{ return this.label;

}

public static void main(String[] args) {

// create the leaf nodes [species]

PhylogramNode human = new PhylogramNode("Human",

0.1);

PhylogramNode bonobo = new PhylogramNode("Bonobo",

0.4);

PhylogramNode chimp = new

PhylogramNode("Chimpanzee", 0.12);

PhylogramNode gorilla = new PhylogramNode("Gorilla",

0.2);

PhylogramNode orangutan = new

PhylogramNode("Orangutan", 0.3);

// create the internal nodes

PhylogramNode node1 = new PhylogramNode("N1", 0.6);

PhylogramNode node2 = new PhylogramNode("N2", 0.4);

PhylogramNode node3 = new PhylogramNode("N3", 0.5); PhylogramNode node4 = new PhylogramNode("N4", 0);

// connect the nodes together to form the phylogram node1.addChild(chimp); node1.addChild(bonobo); node2.addChild(node1); node2.addChild(human); node3.addChild(gorilla); node3.addChild(node2); node4.addChild(orangutan); node4.addChild(node3);

// print out the phylogram printPhylogram(node4, " ");

}

// recursive function to print out the phylogram

public static void printPhylogram(PhylogramNode node, String

indent) {

System.out.println(indent + node.getLabel() + " -- " +

node.getBranchLength());

for (PhylogramNode child : node.getChildren())

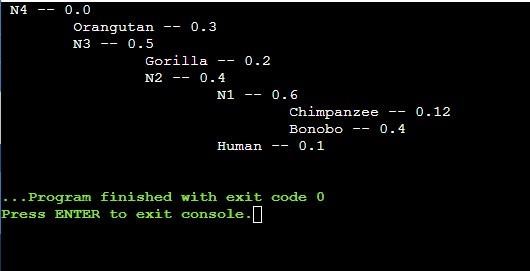
{ printPhylogram(child, indent + "\t");

}

}

}

**Output :**



**Conclusion:**

In conclusion, understanding the concept of phylogenetic trees is essential for exploring the evolutionary history of life on Earth. By representing the evolutionary relationships among a group of organisms, phylogenetic trees provide a powerful tool for visualizing and analyzing complex biological data. Through the use of various methods, such as molecular data or morphological characteristics, scientists can reconstruct the evolutionary history of life on Earth and construct phylogenetic trees to illustrate these relationships. Implementing phylogenetic trees as a data structure can help to organize and analyze biological data, compare and classify organisms, and generate predictions about the evolutionary history of a group of organisms. Overall, the use of phylogenetic trees is crucial in fields such as evolutionary biology, systematics, and biogeography, and will continue to play an important role in advancing our understanding of the diversity of life on Earth.