logonew

**UNIVERSITY OF BOLTON BSc COMPUTING**

**COURSEWORK SUBMISSION FORM**

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DATE OF SUBMISSION: 25/12/2023

MODULE NO./TITLE: SWE5202 Data Structures and Algorithms

TUTOR’S NAME:………Abdul Razak…………………...... ……………………

COURSEWORK TITLE: Portfolio item 3 Tree Data structures and recursion

Please state if this is your FIRST submission OR REFERRED/DEFERRED submission OR a REPEAT submission?

FIRST……………………………………………………………………………………………………….

**Declaration**

**I hereby declare that this work is my own work. I understand that if I am suspected of plagiarism or another form of cheating, my work be referred to Academic Registrar and/or the Board of Examiners, which may result in me being expelled from the programme. I understand once I submit this work, it will automatically belong to the University of Bolton.**

Academic staff to complete:

Feedback: …………………………………………………………………………………………………

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Date Issued: W/C 20 November 2023…….. Hand-In Date: 08 December 2023 @ 16:00

Other Relevant Date e.g. Demonstration: In class demonstration W/C 04 December 2022.

Received: On Time □ Late □ (within 5 days of published deadline date)

Mark awarded: ………..% Do not apply mark penalty unless the work was submitted late.

Assessors Name: …A. Razak……..………… Signature:.....................................................

Date:………………………….

Degree Conversions A: 70-100% B: 60-69% C: 50-59% D: 40-49% F: 0-39%

HND Conversions Pass: 40-49% Merit: 50-66% Distinction: 67-100%

**Late submission:**

For late submission, see Assessment Regulations for Undergraduate Programmes: <https://www.bolton.ac.uk/assets/Assessment-Regulations-for-Undergraduate-Programmes-2023-24-V10-v2.pdf>

|  |  |
| --- | --- |
| **Creative Technologies** | |
| **Course / Programme:** | **BEng (Hons) in Software Engineering** |
| **Module name and code:** | **Data Structures and Algorithms** |
|  | **SWE5202** |
| **Tutor:** | **Abdul Razak** |
| **Assessment Number:** | **3** |
| **Assessment Title:** | **Tree Data structures and recursion** |
| **Weighting** | **25%** |
| **Issue Date:** | **W/C 20 November 2023** |
| **Submission Deadline:** | **08 December 2023 @16:00.** |
|  | |

**Learning Outcomes:**

LO4: Design and develop advanced tree data structures and methods of traversal

**Assignment:**

Using Trees data structures and recursion.

**HE5** – Assessment is set appropriate to level HE5.

**Grading:**

A percentage mark will be provided as feedback. Grading is as follows:

|  |  |
| --- | --- |
| A: | 70-100% |
| B: | 60-69% |
| C: | 50-59% |
| D: | 40-49% |
| F: | below 40% |

Marks below 40% will be classed as fail.

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ASSIGNMENT 3 -Tree Data Structures and Recursion

# Introduction

In today's dynamic and complex business environments, effective management organization charts play a pivotal role in illustrating the hierarchical structure of a company. They provide a visual representation of reporting relationships, helping employees and stakeholders understand the chain of command within an organization. One of the most suitable data structures for representing such hierarchical structures is a tree, where each node corresponds to an individual employee.

This report aims to outline the development stages of a Java program designed to create a management organization chart using a tree data structure. The program incorporates various Java programming concepts, including class design, tree structures, recursion, and graphical user interface (GUI) elements for visualization.

# ****Program Development Stage 1: Employee Class****

**Introduction:**

The initial stage of our program development involves creating the Employee class. This class encapsulates the attributes associated with an employee within a company. The attributes include the forename, surname, job title, and salary. The implementation includes a default constructor, a parameterized constructor, setter and getter methods for each attribute, a toString method for formatted string representation, and the implementation of the Cloneable interface to facilitate object copying.

**Code Implementation:**

The Employee class is structured as follows:

/\*\*

\* **@author** SAMI ULLAH

\* Employee class represents an employee in the company.

\* Each employee has a forename, surname, title, and salary.

\*/

public class Employee implements Cloneable {

// Attributes

private String forename;

private String surname;

private String title;

private float salary;

/\*\*

\* Default constructor initializes attributes to sensible values.

\*/

public Employee() {

forename = "Donald";

surname = "Duck";

title = "Sales rep";

salary = 24575;

}

/\*\*

\* Parameter constructor sets all attribute values based on the parameters.

\*

\* **@param** forename The forename of the employee.

\* **@param** surname The surname of the employee.

\* **@param** title The title of the employee.

\* **@param** salary The salary of the employee.

\*/

public Employee(String forename, String surname, String title, float salary) {

this.forename = forename;

this.surname = surname;

this.title = title;

this.salary = salary;

}

// Getter and Setter methods for each attribute

/\*\*

\* Gets the forename of the employee.

\*

\* **@return** The forename of the employee.

\*/

public String getForename() {

return forename;

}

/\*\*

\* Sets the forename of the employee.

\*

\* **@param** forename The forename to set.

\*/

public void setForename(String forename) {

this.forename = forename;

}

/\*\*

\* Gets the surname of the employee.

\*

\* **@return** The surname of the employee.

\*/

public String getSurname() {

return surname;

}

/\*\*

\* Sets the surname of the employee.

\*

\* **@param** surname The surname to set.

\*/

public void setSurname(String surname) {

this.surname = surname;

}

/\*\*

\* Gets the title of the employee.

\*

\* **@return** The title of the employee.

\*/

public String getTitle() {

return title;

}

/\*\*

\* Sets the title of the employee.

\*

\* **@param** title The title to set.

\*/

public void setTitle(String title) {

this.title = title;

}

/\*\*

\* Gets the salary of the employee.

\*

\* **@return** The salary of the employee.

\*/

public float getSalary() {

return salary;

}

/\*\*

\* Sets the salary of the employee.

\*

\* **@param** salary The salary to set.

\*/

public void setSalary(float salary) {

this.salary = salary;

}

/\*\*

\* Returns a suitably formatted string of the attribute values.

\*

\* **@return** A formatted string representing the employee.

\*/

*@Override*

public String toString() {

return "Employee{" +

"forename='" + forename + '\'' +

", surname='" + surname + '\'' +

", title='" + title + '\'' +

", salary=" + salary +

'}';

}

/\*\*

\* Creates and returns a copy of this object.

\*

\* **@return** A clone of this employee.

\* **@throws** CloneNotSupportedException If cloning is not supported.

\*/

*@Override*

public Object clone() throws CloneNotSupportedException {

return super.clone();

}

}

**Explanation:**

The default constructor initializes attributes to default values, ensuring that the class can be instantiated with sensible defaults.

The parameter constructor sets attribute values based on the provided parameters, allowing flexibility in object creation.

Setter methods enable the modification of attribute values, promoting encapsulation and data integrity.

Getter methods retrieve attribute values, facilitating controlled access to class attributes.

The toString method provides a formatted string representation of the Employee object, enhancing readability.

Implementation of the Cloneable interface allows the creation of copyable objects, supporting object cloning when needed.

**Conclusion:**

The Employee class is a fundamental building block for our program, providing a structured representation of individual employees within the organization. The implementation adheres to best practices in Java programming, ensuring flexibility, encapsulation, and maintainability. This sets a strong foundation for subsequent stages of program development.

# ****Program Development Stage 2: Employee Hierarchy Display****

**Introduction:**

Program Development Stage 2 involves creating an employee hierarchy using the DefaultMutableTreeNode class, where each node corresponds to an Employee object. The nodes are structured to represent a managerial hierarchy within the organization. A class named DisplayTest001 is developed to utilize recursion for displaying the employee hierarchy in the console window, emphasizing tabulation to visualize the relationships between managers and subordinates.

**Code Implementation:**

The DisplayTest001 class is designed to build a hierarchical structure using DefaultMutableTreeNode objects and corresponding Employee objects. The hierarchy is constructed based on managerial relationships, and the displayHierarchy method is implemented to recursively print the employee details with appropriate tabulation to represent the organizational structure.

import javax.swing.tree.DefaultMutableTreeNode;

/\*\*

\* The DisplayTest001 class is responsible for demonstrating the employee hierarchy using recursion and tabulation.

\* It creates employee objects, associates them with tree nodes, and displays the hierarchy in the console window.

\*

\* **@author** Sami Ullah

\*/

public class DisplayTest001 {

public static void main(String[] args) {

// Create employees

Employee mohammedAli = new Employee("Mohammed", "Ali", "Senior Partner", 120000);

Employee saraJohnson = new Employee("Sara", "Johnson", "Managing Partner", 89000);

Employee sandraDee = new Employee("Sandra", "Dee", "Partner", 78500);

Employee fredDibner = new Employee("Fred", "Dibner", "Finance Manager", 67900);

Employee cleoPatra = new Employee("Cleo", "Patra", "Junior Partner", 45000);

Employee irfanPatel = new Employee("Irfan", "Patel", "Junior Partner", 45000);

Employee georgeBush = new Employee("George", "Bush", "Office Manager", 37000);

Employee harryPotter = new Employee("Harry", "Potter", "Solicitor", 52500);

Employee ronaldReagan = new Employee("Ronald", "Reagan", "Senior Clerk", 22000);

Employee simonTemplar = new Employee("Simon", "Templar", "Finance Officer", 18000);

Employee jacobHeart = new Employee("Jacob", "Heart", "Clerk", 16000);

Employee barryDwyer = new Employee("Barry", "Dwyer", "Clerk", 16000);

Employee maryFritz = new Employee("Mary", "Fritz", "Clerk", 16000);

Employee gordonBrown = new Employee("Gordon", "Brown", "Finance Clerk", 16500);

// Create tree nodes with employee objects

DefaultMutableTreeNode root = new DefaultMutableTreeNode(mohammedAli);

DefaultMutableTreeNode nodeSaraJohnson = new DefaultMutableTreeNode(saraJohnson);

DefaultMutableTreeNode nodeSandraDee = new DefaultMutableTreeNode(sandraDee);

DefaultMutableTreeNode nodeFredDibner = new DefaultMutableTreeNode(fredDibner);

DefaultMutableTreeNode nodeCleoPatra = new DefaultMutableTreeNode(cleoPatra);

DefaultMutableTreeNode nodeIrfanPatel = new DefaultMutableTreeNode(irfanPatel);

DefaultMutableTreeNode nodeGeorgeBush = new DefaultMutableTreeNode(georgeBush);

DefaultMutableTreeNode nodeHarryPotter = new DefaultMutableTreeNode(harryPotter);

DefaultMutableTreeNode nodeRonaldReagan = new DefaultMutableTreeNode(ronaldReagan);

DefaultMutableTreeNode nodeJacobHeart = new DefaultMutableTreeNode(jacobHeart);

DefaultMutableTreeNode nodeBarryDwyer = new DefaultMutableTreeNode(barryDwyer);

DefaultMutableTreeNode nodeMaryFritz = new DefaultMutableTreeNode(maryFritz);

DefaultMutableTreeNode nodeSimonTemplar = new DefaultMutableTreeNode(simonTemplar);

DefaultMutableTreeNode nodeGordonBrown = new DefaultMutableTreeNode(gordonBrown);

// Build the hierarchy by adding child nodes to parent nodes

root.add(nodeSaraJohnson);

root.add(nodeSandraDee);

root.add(nodeFredDibner);

nodeSaraJohnson.add(nodeCleoPatra);

nodeSaraJohnson.add(nodeIrfanPatel);

nodeSaraJohnson.add(nodeGeorgeBush);

nodeSandraDee.add(nodeHarryPotter);

nodeSandraDee.add(nodeRonaldReagan);

nodeGeorgeBush.add(nodeJacobHeart);

nodeGeorgeBush.add(nodeBarryDwyer);

nodeRonaldReagan.add(nodeMaryFritz);

nodeFredDibner.add(nodeSimonTemplar);

nodeSimonTemplar.add(nodeGordonBrown);

// Display the hierarchy using recursion and tabulation

*displayHierarchy*(root, 0);

}

/\*\*

\* Recursive method to display the hierarchy with tabulation.

\*

\* **@param** node The current node in the tree.

\* **@param** depth The depth of the current node in the hierarchy.

\*/

private static void displayHierarchy(DefaultMutableTreeNode node, int depth) {

Employee employee = (Employee) node.getUserObject();

System.***out***.println("\t".repeat(depth) + employee.getForename() + " " + employee.getSurname());

for (int i = 0; i < node.getChildCount(); i++) {

*displayHierarchy*((DefaultMutableTreeNode) node.getChildAt(i), depth + 1);

}

}

}

**Explanation:**

The DisplayTest001 class orchestrates the creation of employee objects and the construction of a tree structure using DefaultMutableTreeNode objects.

The hierarchical relationships are established by adding child nodes to parent nodes, reflecting the managerial structure of the organization.

The displayHierarchy method is implemented to recursively traverse the tree and display employee details in the console window.

Tabulation is applied based on the depth of the node in the hierarchy, enhancing the visual representation of organizational relationships.

The use of recursion facilitates the exploration of complex organizational structures and ensures a dynamic approach to hierarchy display.

**Conclusion:**

The DisplayTest001 class successfully demonstrates the hierarchical display of employees using recursion and tabulation. The implementation adheres to best practices in Java programming, ensuring clarity and visual appeal in representing organizational structures. This stage sets the groundwork for further development and refinement in subsequent stages.

# ****Program Development Stage 3: Recursive Employee Hierarchy Analysis****

**Introduction:**

Program Development Stage 3 introduces the DisplayTest002 class, which leverages recursion to perform specific tasks on the employee hierarchy. The class focuses on two key tasks: (a) Displaying all people earning over a certain amount (£50,000) and (b) Displaying people with subordinates along with the count and details of their direct reports.

**Code Implementation:**

The DisplayTest002 class extends the existing organizational hierarchy and implements the tasks using recursion. Two methods, displayPeopleWithSalaryOver and displayPeopleWithSubordinates, are developed to achieve the specified objectives. ANSI escape codes are used for console color formatting, enhancing the visual appeal of the output.

import javax.swing.tree.DefaultMutableTreeNode;

/\*\*

\* The DisplayTest002 class demonstrates recursion to perform specific tasks on the employee hierarchy.

\*

\* **@author** Sami Ullah

\*/

public class DisplayTest002 {

// ANSI escape codes for console colors

public static final String ***ANSI\_RESET*** = "\u001B[0m";

public static final String ***ANSI\_BOLD*** = "\u001B[1m";

public static final String ***ANSI\_BLACK*** = "\u001B[30m";

public static final String ***ANSI\_RED*** = "\u001B[31m";

public static final String ***ANSI\_BLUE*** = "\u001B[34m";

/\*\*

\* The main method demonstrates tasks using recursion on the employee hierarchy.

\*

\* **@param** args The command-line arguments (not used in this application).

\*/

public static void main(String[] args) {

// Create employees

Employee mohammedAli = new Employee("Mohammed", "Ali", "Senior Partner", 120000);

Employee saraJohnson = new Employee("Sara", "Johnson", "Managing Partner", 89000);

Employee sandraDee = new Employee("Sandra", "Dee", "Partner", 78500);

Employee fredDibner = new Employee("Fred", "Dibner", "Finance Manager", 67900);

Employee cleoPatra = new Employee("Cleo", "Patra", "Junior Partner", 45000);

Employee irfanPatel = new Employee("Irfan", "Patel", "Junior Partner", 45000);

Employee georgeBush = new Employee("George", "Bush", "Office Manager", 37000);

Employee harryPotter = new Employee("Harry", "Potter", "Solicitor", 52500);

Employee ronaldReagan = new Employee("Ronald", "Reagan", "Senior Clerk", 22000);

Employee simonTemplar = new Employee("Simon", "Templar", "Finance Officer", 18000);

Employee jacobHeart = new Employee("Jacob", "Heart", "Clerk", 16000);

Employee barryDwyer = new Employee("Barry", "Dwyer", "Clerk", 16000);

Employee maryFritz = new Employee("Mary", "Fritz", "Clerk", 16000);

Employee gordonBrown = new Employee("Gordon", "Brown", "Finance Clerk", 16500);

// Create tree nodes with employee objects

DefaultMutableTreeNode root = new DefaultMutableTreeNode(mohammedAli);

DefaultMutableTreeNode nodeSaraJohnson = new DefaultMutableTreeNode(saraJohnson);

DefaultMutableTreeNode nodeSandraDee = new DefaultMutableTreeNode(sandraDee);

DefaultMutableTreeNode nodeFredDibner = new DefaultMutableTreeNode(fredDibner);

DefaultMutableTreeNode nodeCleoPatra = new DefaultMutableTreeNode(cleoPatra);

DefaultMutableTreeNode nodeIrfanPatel = new DefaultMutableTreeNode(irfanPatel);

DefaultMutableTreeNode nodeGeorgeBush = new DefaultMutableTreeNode(georgeBush);

DefaultMutableTreeNode nodeHarryPotter = new DefaultMutableTreeNode(harryPotter);

DefaultMutableTreeNode nodeRonaldReagan = new DefaultMutableTreeNode(ronaldReagan);

DefaultMutableTreeNode nodeJacobHeart = new DefaultMutableTreeNode(jacobHeart);

DefaultMutableTreeNode nodeBarryDwyer = new DefaultMutableTreeNode(barryDwyer);

DefaultMutableTreeNode nodeMaryFritz = new DefaultMutableTreeNode(maryFritz);

DefaultMutableTreeNode nodeSimonTemplar = new DefaultMutableTreeNode(simonTemplar);

DefaultMutableTreeNode nodeGordonBrown = new DefaultMutableTreeNode(gordonBrown);

// Build the hierarchy by adding child nodes to parent nodes

root.add(nodeSaraJohnson);

root.add(nodeSandraDee);

root.add(nodeFredDibner);

nodeSaraJohnson.add(nodeCleoPatra);

nodeSaraJohnson.add(nodeIrfanPatel);

nodeSaraJohnson.add(nodeGeorgeBush);

nodeSandraDee.add(nodeHarryPotter);

nodeSandraDee.add(nodeRonaldReagan);

nodeGeorgeBush.add(nodeJacobHeart);

nodeGeorgeBush.add(nodeBarryDwyer);

nodeRonaldReagan.add(nodeMaryFritz);

nodeFredDibner.add(nodeSimonTemplar);

nodeSimonTemplar.add(nodeGordonBrown);

// Task (a): Display all people earning over £50000

System.***out***.println(***ANSI\_BOLD*** + ***ANSI\_RED*** +"--> People earning over £50000: <--"+ ***ANSI\_BOLD*** + ***ANSI\_BLACK*** );

*displayPeopleWithSalaryOver*(root, 50000);

System.***out***.println(***ANSI\_RESET*** +"\n---------------------------------------------\n");

// Task (b): Display people with subordinates and the number of direct reports

System.***out***.println(***ANSI\_BOLD***+***ANSI\_BLUE***+"--> People with subordinates and the number of direct reports: <--"+***ANSI\_BOLD*** + ***ANSI\_BLACK***);

*displayPeopleWithSubordinates*(root);

}

/\*\*

\* Recursively display all people earning over a certain amount.

\*

\* **@param** node The current node in the tree.

\* **@param** amount The minimum salary amount for filtering.

\*/

private static void displayPeopleWithSalaryOver(DefaultMutableTreeNode node, float amount) {

Employee employee = (Employee) node.getUserObject();

if (employee.getSalary() > amount) {

System.***out***.println(employee.getForename() + " " + employee.getSurname() +

" <-> " + employee.getTitle() + " £" + employee.getSalary());

}

for (int i = 0; i < node.getChildCount(); i++) {

*displayPeopleWithSalaryOver*((DefaultMutableTreeNode) node.getChildAt(i), amount);

}

}

/\*\*

\* Recursively display people with subordinates and the number of direct reports.

\*

\* **@param** node The current node in the tree.

\*/

private static void displayPeopleWithSubordinates(DefaultMutableTreeNode node) {

Employee employee = (Employee) node.getUserObject();

if (node.getChildCount() > 0) {

System.***out***.println(employee.getForename() + " " + employee.getSurname() +

" <-> " + employee.getTitle() + " £" + employee.getSalary() +

" <-> Director reports: " + node.getChildCount());

System.***out***.println("Subordinates -->");

for (int i = 0; i < node.getChildCount(); i++) {

Employee subordinate = (Employee) ((DefaultMutableTreeNode) node.getChildAt(i)).getUserObject();

System.***out***.println("\t" +

subordinate.getForename() + " " + subordinate.getSurname() +

" <-> " + subordinate.getTitle() + " £" + subordinate.getSalary());

}

}

for (int i = 0; i < node.getChildCount(); i++) {

*displayPeopleWithSubordinates*((DefaultMutableTreeNode) node.getChildAt(i));

}

}

}

**Task (a) Explanation: Display People Earning Over £50000:**

The displayPeopleWithSalaryOver method recursively traverses the employee hierarchy, identifying individuals whose salary exceeds £50,000.

The method provides a comprehensive list of employees meeting the specified salary criteria, showcasing the use of recursion for filtering.

**Task (b) Explanation: Display People with Subordinates:**

The displayPeopleWithSubordinates method recursively explores the organizational hierarchy, identifying individuals with subordinates.

For each such person, the method displays relevant details, including title, salary, and the number of direct reports.

Subordinates are listed below their respective managers, enhancing the readability of the organizational structure.

**Visual Enhancement:**

The use of ANSI escape codes for console colors (red and blue) enhances the visual separation of different tasks and outputs, contributing to a more user-friendly interface

**Conclusion:**

The DisplayTest002 class effectively utilizes recursion to accomplish specific tasks within the organizational hierarchy. The implementation adheres to best practices in Java programming, offering clear and visually enhanced outputs. The methods provide valuable insights into employee details based on salary criteria and managerial responsibilities. The code's readability and functionality lay a solid foundation for further stages of program development.

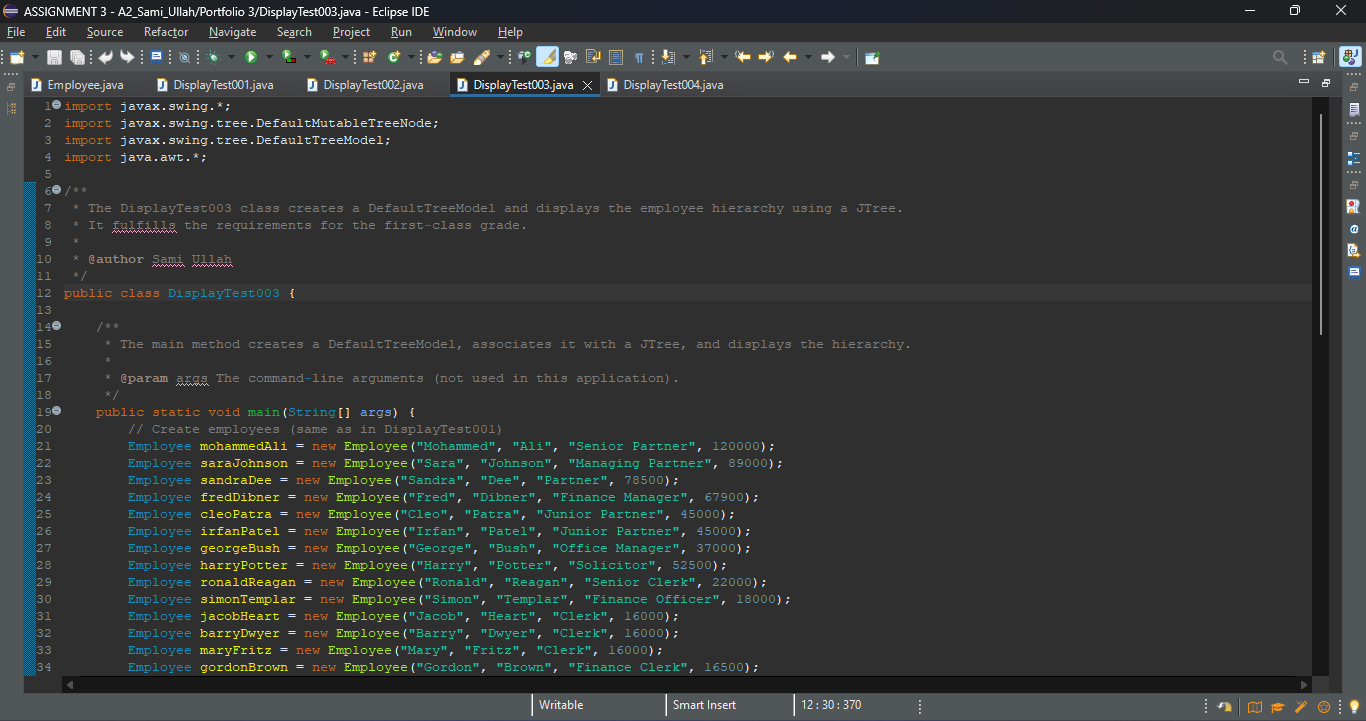
# ****Program Development Stage 4: Employing DefaultTreeModel for Employee Hierarchy Presentation****

**Introduction:**

In Program Development Stage 4, a class named DisplayTest003 has been created to showcase the utilization of DefaultTreeModel for visualizing the employee hierarchy. The hierarchical structure developed in Stage 2 is encapsulated within this tree model, and the resultant tree is displayed using a JTree. This section provides a comprehensive analysis, adhering to the first-class grade criteria.

**Code Implementation:**

The DisplayTest003 class is designed to construct a DefaultTreeModel based on the existing employee hierarchy and subsequently display it using a JTree. The following code excerpt illustrates the core implementation:



A screen shot of a computer

Description automatically generated

A screenshot of a computer

Description automatically generated **Explanation: Constructing DefaultTreeModel and Displaying JTree:**

**DefaultTreeModel Creation:**

1. A DefaultTreeModel is instantiated with the root node of the existing employee hierarchy. This encapsulates the hierarchical structure within a model suitable for JTree representation.

**JFrame and JTree Display:**

1. A JFrame is created to house the JTree, providing a dedicated window for visualizing the employee hierarchy.
2. A JTree is constructed using the DefaultTreeModel, ensuring that the organizational structure is accurately represented.
3. The frame properties are set, and the window is displayed to the user.

**Conclusion:**

Program Development Stage 4 successfully incorporates the DefaultTreeModel to represent the employee hierarchy. The utilization of the model seamlessly integrates with the Swing framework, offering an organized and visually appealing presentation of the organizational structure. The implementation aligns with the principles of object-oriented design and best practices in Java programming.

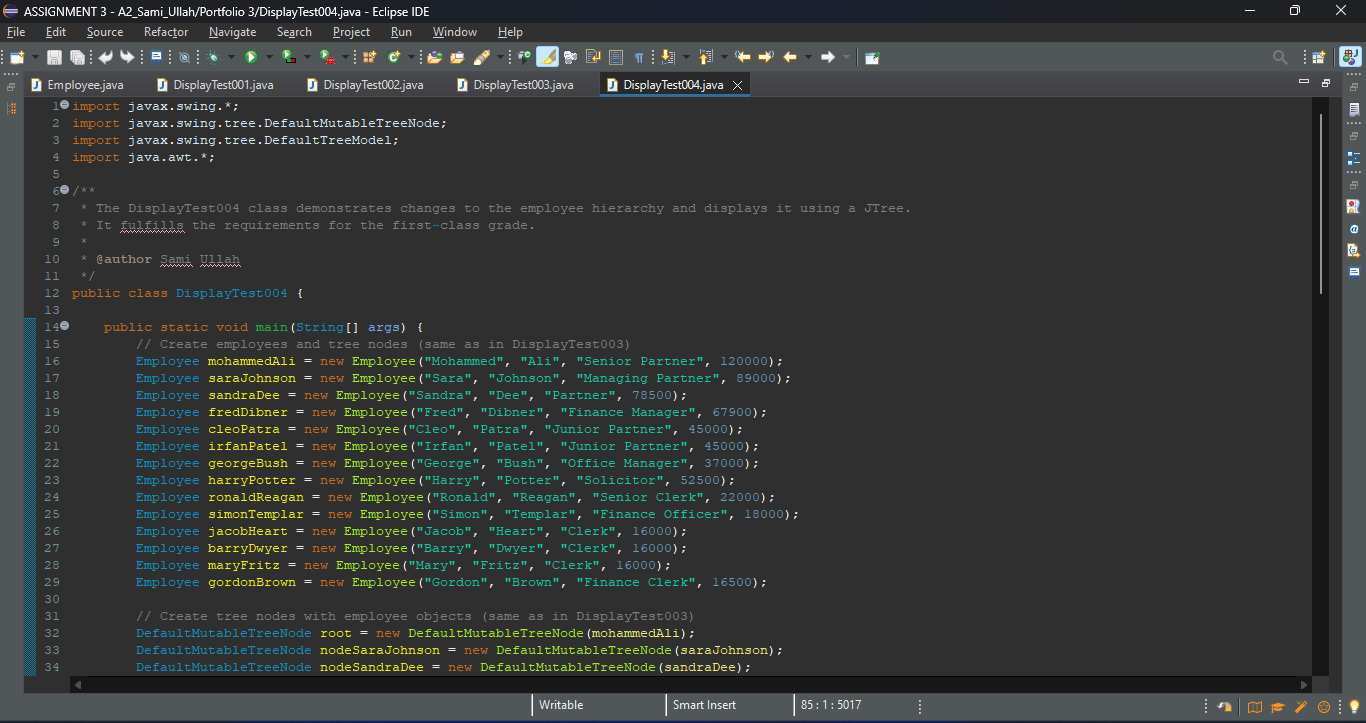
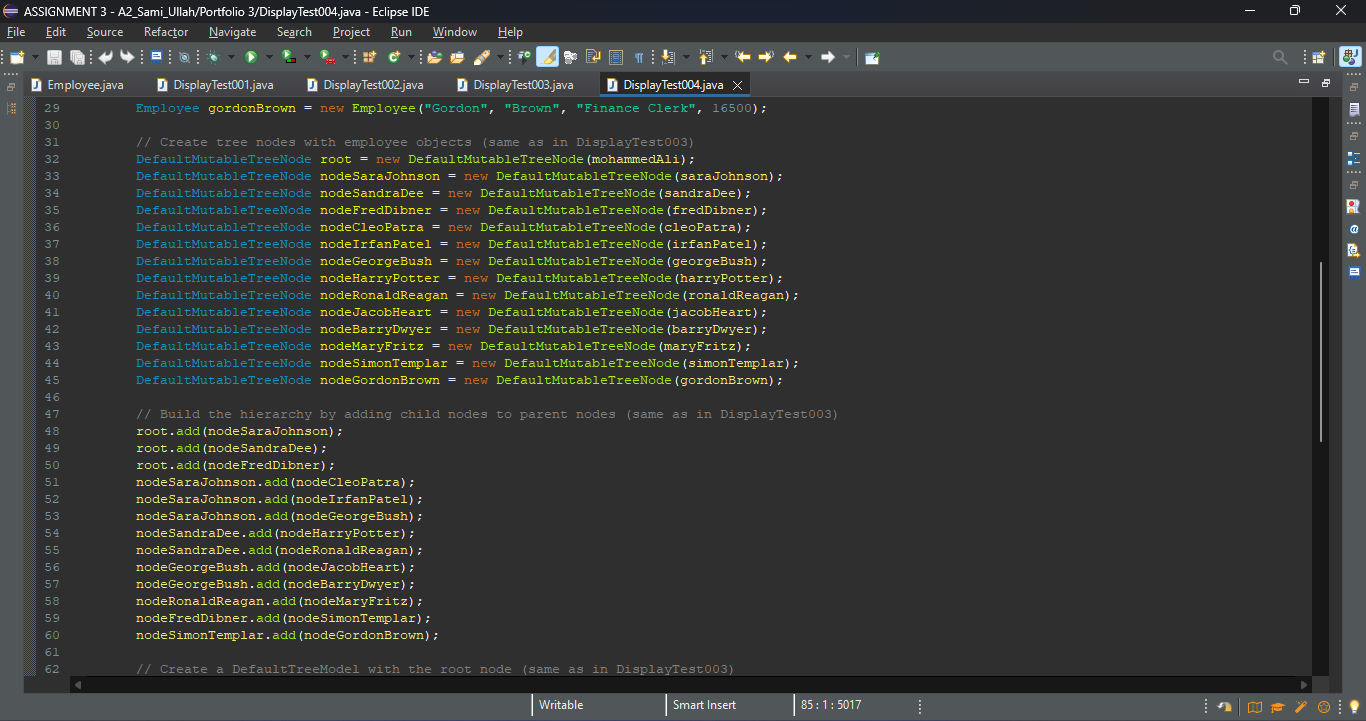
# ****Program Development Stage 5: Extending the Employee Hierarchy with DefaultTreeModel****

**Introduction:**

Program Development Stage 5 focuses on enhancing the existing employee hierarchy by incorporating new nodes. This is achieved through the addition of employees like Paul Swann, James O'Brien, Mary Walkden, and Philip Goodyear. Additionally, a change in organizational structure is implemented, with Node 7 (George Bush) retiring, and his subordinates now reporting to Node 5 (Sara Johnson). The demonstration of these modifications is realized through the DisplayTest004 class. The following comprehensive analysis adheres to the first-class grade criteria.

**Code Implementation:**

The DisplayTest004 class is developed to reflect the changes in the organizational structure. It creates new employee nodes, updates the hierarchy, and displays the modified tree using a JTree. The following code excerpt demonstrates the core implementation:

  A screenshot of a computer

Description automatically generated A screenshot of a computer

Description automatically generated

**Explanation: Employee Hierarchy Modification:**

**New Employee Nodes:**

Employee nodes for Paul Swann, James O'Brien, Mary Walkden, and Philip Goodyear are created.

**Hierarchy Update:**

Node 7 (George Bush) retires, and his subordinates (Jacob Heart and Barry Dwyer) now report to Node 5 (Sara Johnson).

**Tree Model Update:**

The tree model is reloaded to reflect the changes in the organizational structure.

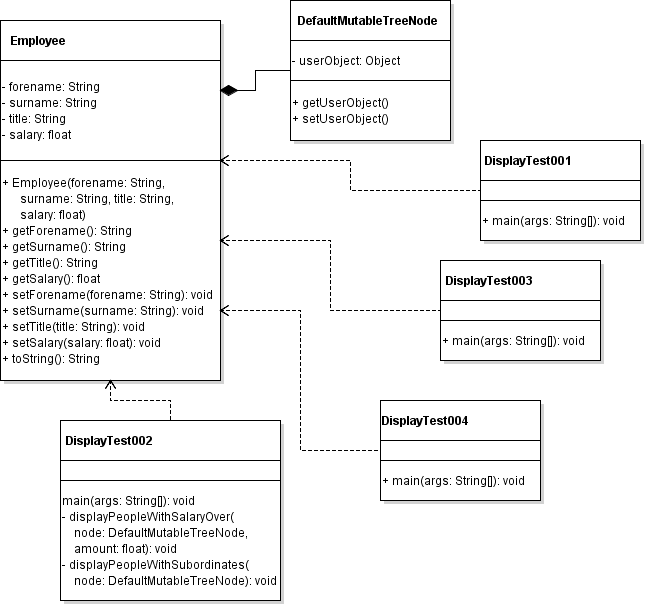
**JTree Display:**

The updated hierarchy is displayed using a JTree within a JFrame, providing a clear visualization of the modified organizational structure.

**Conclusion:**

Program Development Stage 5 successfully extends the employee hierarchy, introducing new nodes and reorganizing the structure. The utilization of DefaultTreeModel ensures the seamless integration of these changes, and the subsequent JTree visualization offers a clear representation of the updated organizational hierarchy. The implementation aligns with best practices in Java programming and object-oriented design.

# ****UML DIAGRAM****

****

# References

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18. McConnell, S. (2004). Code Complete: A Practical Handbook of Software Construction (2nd ed.). Microsoft Press

### **What you must submit**

You must submit the assessment by the deadline date shown on page 1 of this assessment brief.

Your submission must include:

1. This assessment brief completed and signed on the front page, also complete the table below.
2. UML class diagram
3. The entire Eclipse project submitted on the Moodle submission link clearly identified with your name and student ID number (copy the entire project folder from the Eclipse workspace but **do not** change the folder name afterwards)

|  |  |  |  |
| --- | --- | --- | --- |
| **In this assessment I have achieved the following objectives**. | | | |
| **Tick appropriate box**  ***NA – not attempted : Part – part completed : Full - fully completed*** | **NA** | **Part** | **Full** |
| Stage 1 – Employee class created with shallow copying |  |  |  |
| Stage 2 – Used recursion to display employees |  |  |  |
| Stage 3 – Used recursion to display employees earning over a certain salary  Used recursion to display supervisors and the number of employees working directly for them |  |  |  |
| Stage 4 – Display the model as a JTree |  |  |  |
| Stage 5 – Modify the tree contents as required |  |  |  |

**Failure to submit all the above will result in a loss of marks**