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**Звіт**

**Лабораторна робота 9**

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**Реалізація ітераторів у контейнерах у .NET Framework**

**Мета роботи**: Дослідити та реалізувати механізм ітерації для узагальнених класів-контейнерів (Container<T> на основі масиву та ContainerLinkedList<T> на основі двозв'язного списку) шляхом явної реалізації інтерфейсів IEnumerable<T> та IEnumerator<T> без використання ключового слова yield.

# Завдання

В рамках даної роботи необхідно:

Модифікувати узагальнені класи-контейнери (Container<T> та ContainerLinkedList<T>), розроблені в попередній лабораторній роботі, для реалізації інтерфейсу IEnumerable<T>.

Для кожного типу контейнера розробити власний клас-ітератор (або використати сам клас контейнера як ітератор), який реалізує інтерфейс IEnumerator<T>.

Реалізація ітераторів не повинна використовувати ключове слово yield. Необхідно явно реалізувати методи MoveNext(), Reset() та властивість Current.

Забезпечити можливість використання циклу foreach для перебору елементів в обох типах контейнерів.

Переконатися, що існуюча функціональність контейнерів (додавання, видалення, сортування, індексатори) залишається працездатною.

# Реалізація коду

## Алгоритм коду

Повний код програми відображено у додатку А.

Для забезпечення можливості ітерації по контейнерах за допомогою foreach без використання yield, було реалізовано інтерфейси IEnumerable<T> та IEnumerator<T> наступним чином:

1. Реалізація ітератора для Container<T> (на основі масиву)

Клас Container<T> тепер реалізує інтерфейс IEnumerable<T>. Було видалено попередню реалізацію методу GetEnumerator(), яка використовувала yield. Створено внутрішній (private nested) клас ContainerEnumerator, який реалізує інтерфейс IEnumerator<T>. Це необхідно, оскільки сам контейнер на основі масиву не може легко відстежувати поточну позицію ітерації для кількох одночасних циклів foreach без зовнішнього об'єкта-ітератора.

Клас ContainerEnumerator містить:

* Посилання на екземпляр Container<T>, щоб мати доступ до масиву items та лічильника count.
* Приватне поле \_currentIndex (int), яке зберігає поточну позицію в масиві під час ітерації (ініціалізується значенням -1).
* Реалізацію властивості Current (з IEnumerator<T>): повертає елемент items[\_currentIndex].
* Реалізацію методу MoveNext(): інкрементує \_currentIndex і повертає true, якщо нова позиція знаходиться в межах дійсних елементів контейнера (менше count), інакше повертає false. Важливо: Цей метод може пропускати null елементи, якщо вони потенційно можуть з'явитися в масиві між дійсними елементами (хоча при поточній реалізації RemoveById це малоймовірно).
* Реалізацію методу Reset(): скидає \_currentIndex на -1.
* Реалізацію методу Dispose(): порожній метод, оскільки ітератор не керує зовнішніми ресурсами.

Метод GetEnumerator() класу Container<T> тепер створює та повертає новий екземпляр ContainerEnumerator(this).Явно реалізовано також не узагальнений метод IEnumerable.GetEnumerator(), який викликає узагальнений GetEnumerator().

2. Реалізація ітератора для ContainerLinkedList<T>

Цей клас вже реалізував інтерфейси IEnumerable<T> та IEnumerator<T> у попередній роботі, причому сам клас виступав у ролі свого ітератора. Цей підхід не використовує yield і відповідає вимогам завдання.

Клас містить поле \_currentNode, яке зберігає посилання на поточний вузол під час ітерації.Властивість Current повертає дані (Data) з \_currentNode.

Метод MoveNext() переміщує \_currentNode на наступний вузол (\_currentNode.Next) і повертає true, якщо наступний вузол існує. При першому виклику він встановлює \_currentNode на голову списку (\_head).

Метод Reset() скидає \_currentNode на null, готуючи до нової ітерації.Метод GetEnumerator() просто повертає this, оскільки клас сам є ітератором.

## Тестування коду

Тестування узагальнення перевірено на етапі компіляції, що контейнери можуть приймати лише об'єкти класів, що реалізують IName зображено на Рис. 1 та Рис. 2, відображення контейнера на Рис. 3.

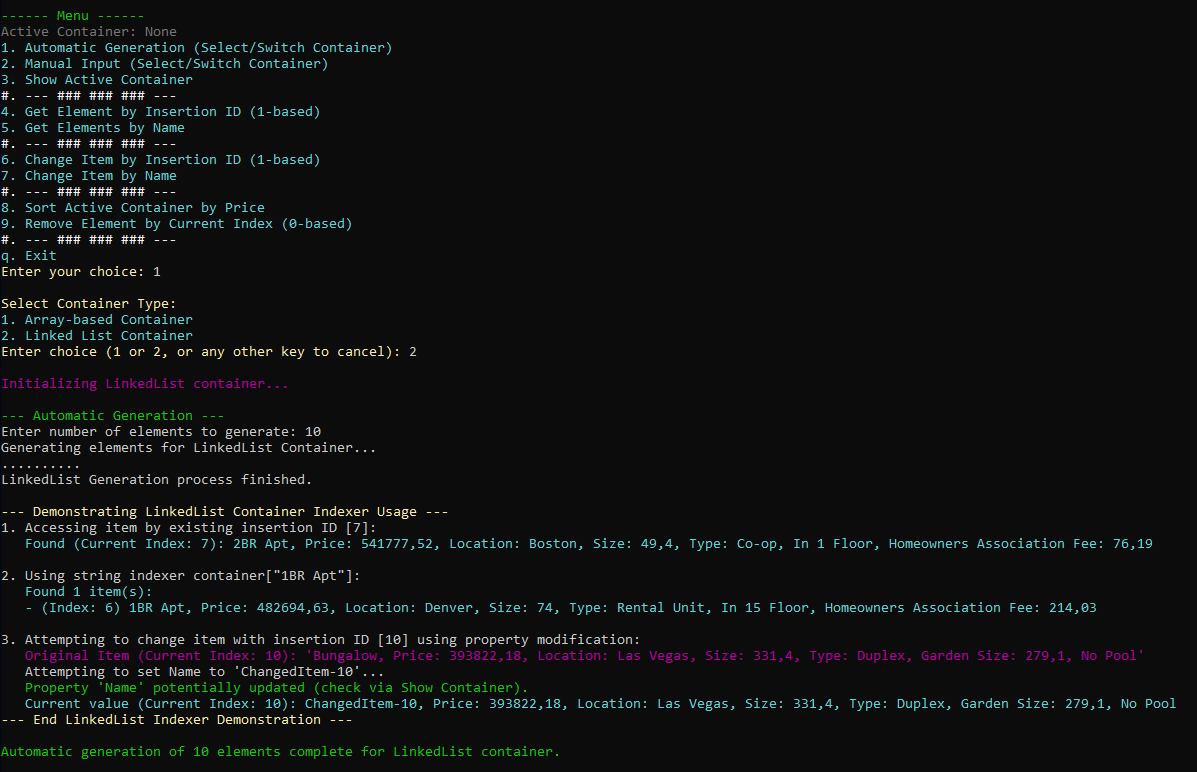


Рис. 1. Тестування додавання згенерованих об'єктів

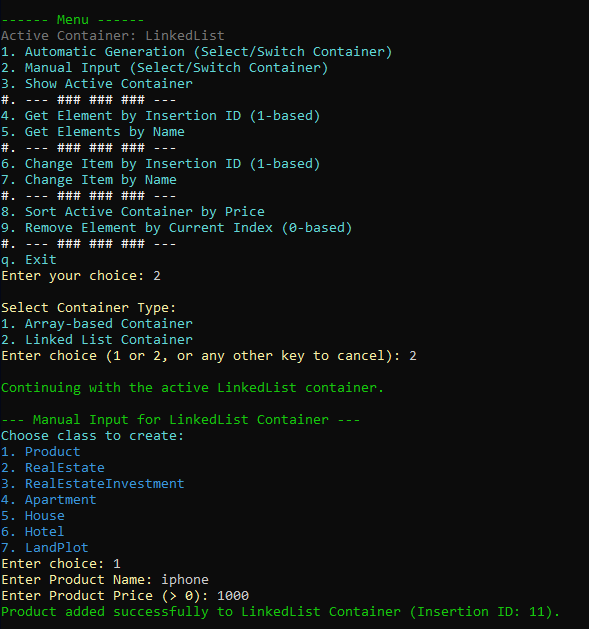


Рис. 2. Тестування введених вручну об'єкту

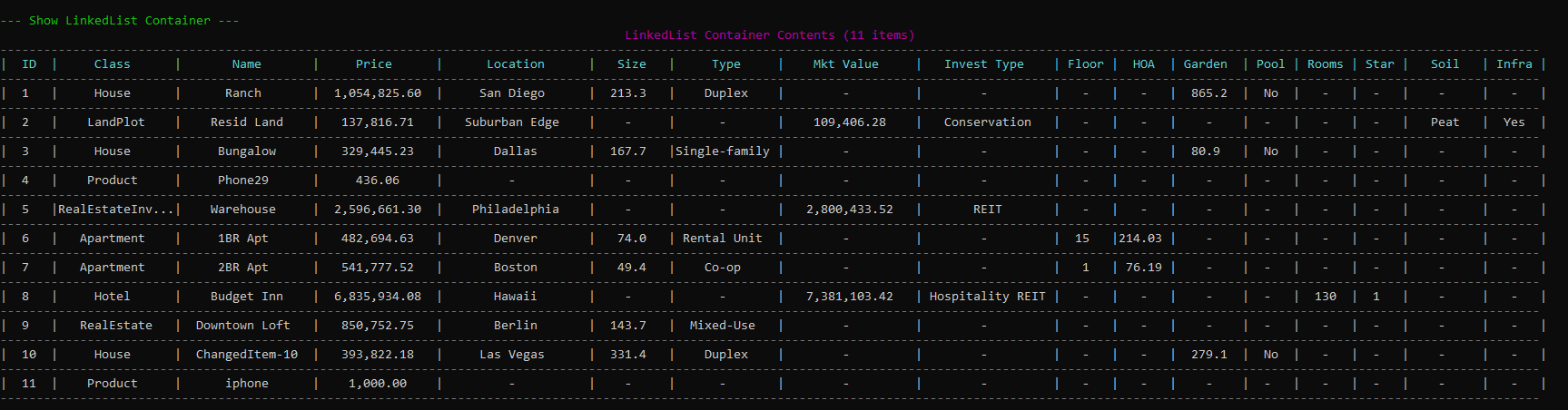


Рис. 3. Відображення контейнера

# Висновок

У ході виконання лабораторної роботи було успішно реалізовано механізм ітерації для узагальнених контейнерів Container<T> (на основі масиву) та ContainerLinkedList<T> (на основі двозв'язного списку) без використання ключового слова yield. Це було досягнуто шляхом явної реалізації інтерфейсів IEnumerable<T> та IEnumerator<T>.

Для контейнера на основі масиву було створено окремий внутрішній клас-ітератор ContainerEnumerator, що керує станом ітерації. Для контейнера на основі двозв'язного списку сам клас було адаптовано для виконання ролі ітератора за допомогою поля \_currentNode.

Реалізація власних ітераторів дозволила глибше зрозуміти принципи роботи циклу foreach та механізмів ітерації у .NET. Обидва контейнери тепер підтримують стандартний патерн ітерації, що робить їх використання більш зручним та універсальним. Також було оновлено логіку сортування для використання відповідних методів порівняння, визначених в інтерфейсі IName.

Проведене тестування підтвердило коректність роботи реалізованих ітераторів та збереження працездатності іншої функціональності контейнерів та програми загалом.

# Додаток А

using System.Collections.Generic;

using lb\_8.Interfaces;

using System.Reflection;

namespace lb\_8

{

class Helper

{

public static V? GetPropertyValue<V>(object item, string propertyName)

{

if (item == null) return default;

PropertyInfo? property = item.GetType().GetProperty(propertyName);

if (property != null && property.CanRead)

{

return (V?)property.GetValue(item);

}

return default;

}

}

class Container<T> where T : class, IName

{

private T?[] items;

private int[] insertionOrder;

private int count;

private int size;

private int nextInsertionId;

public Container()

{

items = new T?[1];

insertionOrder = new int[1];

count = 0;

size = 1;

nextInsertionId = 0;

}

public void Add(T \_newObject)

{

if (count == size)

{

T?[] newArray = new T?[size \* 2];

int[] newInsertionOrder = new int[size \* 2];

for (int i = 0; i < size; i++)

{

newArray[i] = items[i];

newInsertionOrder[i] = insertionOrder[i];

}

items = newArray;

insertionOrder = newInsertionOrder;

size \*= 2;

}

items[count] = \_newObject;

insertionOrder[count] = nextInsertionId++;

count++;

}

public T? RemoveById(int \_index)

{

if (\_index < 0 || \_index > count)

throw new IndexOutOfRangeException();

T? deletedObject = items[\_index]!;

for (int i = \_index; i < count - 1; i++)

{

items[i] = items[i + 1];

insertionOrder[i] = insertionOrder[i + 1];

}

items[count - 1] = default;

insertionOrder[count - 1] = 0;

count--;

return deletedObject;

}

public void Sort()

{

try

{

for (int i = 0; i < count - 1; i++)

{

for (int j = 0; j < count - i - 1; j++)

{

if (Helper.GetPropertyValue<decimal>(items[j], "Price") > Helper.GetPropertyValue<decimal>(items[j + 1], "Price"))

{

(items[j], items[j + 1]) = (items[j + 1], items[j]);

(insertionOrder[j], insertionOrder[j + 1]) = (insertionOrder[j + 1], insertionOrder[j]);

}

}

}

}

catch (Exception e)

{

Console.ForegroundColor = ConsoleColor.Red;

Console.WriteLine(e.Message);

Console.ResetColor();

}

}

public override string ToString()

{

string res = "";

foreach (var item in items)

{

if (item is null)

continue;

res += item.ToString() + "\n";

}

return res;

}

public T?[] GetItems()

{

return items;

}

public int GetCount()

{

return count;

}

public int GetInsertionId()

{

return nextInsertionId;

}

public int[] GetInsertionOrder()

{

return insertionOrder;

}

public bool IsEmpty(bool printMessage = true)

{

if (count == 0)

{

if (printMessage)

{

Console.ForegroundColor = ConsoleColor.Yellow;

Console.WriteLine("Container is empty");

Console.ResetColor();

}

return true;

}

return false;

}

public T[] GetItemsByParameter<Y>(string param, Y i)

{

var \_items = new T[count];

int index = 0;

foreach (var item in items)

{

if (item != null)

{

var value = Helper.GetPropertyValue<Y>(item, param);

if (value != null && value.Equals(i))

{

\_items[index] = item;

index++;

}

}

}

return index == 0 ? default : \_items;

}

public T? GetInstanceByInsertionId(int id)

{

if (id < 0 | id > nextInsertionId) throw new IndexOutOfRangeException($"There is no entry number {id}");

for (int j = 0; j < count; j++)

{

if (insertionOrder[j] == id)

{

return items[j];

}

}

return default;

}

// Insertion order indexer

public T? this[int id]

{

get => GetInstanceByInsertionId(id);

set

{

if (value == null) throw new ArgumentNullException(nameof(value));

T? \_item = GetInstanceByInsertionId(id);

if (\_item != null)

{

\_item = value;

}

throw new IndexOutOfRangeException("Can not find element by this insertion index");

}

}

// Name indexer

public T[] this[string i]

{

get => GetItemsByParameter("Name", i);

}

//// Price indexer

//public T[] this[decimal i]

//{

// get => GetItemsByParameter("Price", i);

//}

}

class ContainerLinkedList<T> where T : class, IName

{

public class Node<V>

{

public V Data { get; set; }

public Node<V> Next { get; set; }

public Node<V> Previous { get; set; }

public Node(V data)

{

Data = data;

Next = null;

Previous = null;

}

}

public ContainerLinkedList()

{

\_head = null;

Count = 0;

InsertionOrder = new List<int>();

NextInsertionId = 0;

}

private Node<T> \_head;

public Node<T> First => \_head;

public Node<T> Last => GetLastNode();

private int \_count;

public int Count

{

get

{

if (\_count < 0)

{

\_count = 0;

}

return \_count;

}

private set => \_count = value;

}

private int NextInsertionId;

private List<int> InsertionOrder;

public void AddFirst(T data)

{

Node<T> newNode = new Node<T>(data);

if (\_head != null)

{

newNode.Next = \_head;

\_head.Previous = newNode;

}

\_head = newNode;

Count++;

InsertionOrder.Add(NextInsertionId++);

}

public void AddLast(T data)

{

Node<T> newNode = new Node<T>(data);

if (\_head == null)

{

\_head = newNode;

}

else

{

Node<T> lastNode = GetLastNode();

lastNode.Next = newNode;

newNode.Previous = lastNode;

}

Count++;

InsertionOrder.Add(NextInsertionId++);

}

private Node<T> GetLastNode()

{

Node<T> node = \_head;

while (node.Next != null)

{

node = node.Next;

}

return node;

}

public T? RemoveByIndex(int index)

{

int count = 0;

var current = \_head;

while (current != null && count < index)

{

current = current.Next;

count++;

}

if (current == null) throw new ArgumentOutOfRangeException(nameof(index));

T? deletedItem = current.Data;

if (current.Previous != null)

current.Previous.Next = current.Next;

else

\_head = current.Next;

if (current.Next != null)

current.Next.Previous = current.Previous;

Count--;

InsertionOrder.RemoveAt(index);

return deletedItem;

}

public void Sort(string sortBy = "Price")

{

if (\_head == null) return;

List<T> list = new List<T>();

for (var node = \_head; node != null; node = node.Next)

{

list.Add(node.Data);

}

BinaryInsertionSort(list, sortBy);

var current = \_head;

foreach (var item in list)

{

current.Data = item;

current = current.Next;

}

}

private void BinaryInsertionSort(List<T> list, string propertyName)

{

for (int i = 1; i < list.Count; i++)

{

int currentInsertionValue = InsertionOrder[i];

T currentItem = list[i];

decimal currentValue = Helper.GetPropertyValue<decimal>(currentItem, propertyName);

int ins = BinarySearch(list, currentValue, propertyName, 0, i);

if (ins < i)

{

list.RemoveAt(i);

list.Insert(ins, currentItem);

InsertionOrder.RemoveAt(i);

InsertionOrder.Insert(ins, currentInsertionValue);

}

}

}

private int BinarySearch(List<T> list, decimal key, string propertyName, int low, int high)

{

while (low < high)

{

int mid = low + (high - low) / 2;

decimal midValue = Helper.GetPropertyValue<decimal>(list[mid], propertyName);

if (key < midValue)

high = mid;

else

low = mid + 1;

}

return low;

}

// Clear Container

public void Clear()

{

\_head = null;

Count = 0;

InsertionOrder.Clear();

NextInsertionId = 0;

}

public int GetNextInsertionId()

{

return NextInsertionId;

}

public List<int> GetInsertionOrder()

{

return InsertionOrder;

}

public override string ToString()

{

if (\_head is null) return "Container is empty.";

string res = string.Empty;

var current = \_head;

while (current != null)

{

res += current.Data?.ToString() + "\n";

current = current.Next;

}

return res;

}

private List<T> GetItemsByParameter<Y>(string parameter, Y i)

{

List<T> values = new List<T>();

var current = \_head;

while (current != null)

{

var propValue = Helper.GetPropertyValue<Y>(current.Data, parameter);

if (propValue != null && propValue.Equals(i))

{

values.Add(current.Data);

}

current = current.Next;

}

return values.Count == 0 ? null : values;

}

// Insortion indexer

public T? this[int index]

{

get

{

var current = \_head;

int count = 0;

while (current != null)

{

if (InsertionOrder[count] == index)

return current.Data;

current = current.Next;

count++;

}

return null;

}

set

{

if (value == null) throw new ArgumentNullException(nameof(value));

var current = \_head;

int count = 0;

while (current != null)

{

if (InsertionOrder[count] == index)

{

current.Data = value;

return;

}

current = current.Next;

count++;

}

throw new IndexOutOfRangeException("Can not find element by this insertion index");

}

}

// Name indexer

public List<T> this[string name]

{

get => GetItemsByParameter<string>("Name", name);

}

}

}

using lb\_8.Interfaces;

namespace lb\_8.Classes

{

class Product : IName, IName<Product>

{

public string Name { get; set; }

public decimal Price { get; set; }

public Product()

{

Name = string.Empty;

Price = 0;

}

public Product(string name, decimal price)

{

if (price <= 0) throw new ValueLessThanZero("Price");

Name = name;

Price = price;

}

public override string ToString()

{

return $"{Name}, Price: {Price}";

}

public int CompareTo(object obj)

{

if (obj == null) return 1;

if (obj is not IName otherProduct)

{

throw new ArgumentException($"Object must be type {nameof(IName)}");

}

return StringComparer.OrdinalIgnoreCase.Compare(this.Name, otherProduct.Name);

}

}

}

using System.ComponentModel;

using System.Globalization;

using System.Reflection;

using lb\_8.Classes;

using lb\_8.Interfaces;

namespace lb\_8;

enum ContainerType

{

None,

Array,

LinkedList

}

class Program

{

static Container<IName>? containerArray = null;

static ContainerLinkedList<IName>? containerList = null;

static ContainerType activeContainerType = ContainerType.None;

static Random random = new Random();

static void Main()

{

while (true)

{

PrintMenu();

string choice = Console.ReadLine()?.ToLower() ?? "";

try

{

switch (choice)

{

case "1": HandleContainerSelectionAndAction(HandleAutomaticGeneration); break;

case "2": HandleContainerSelectionAndAction(HandleManualInput); break;

case "3": HandleShowContainer(); break;

case "4": HandleGetElementByInsertionId(); break;

case "5": HandleGetElementByName(); break;

case "6": HandleChangeItemByInsertionId(); break;

case "7": HandleChangeItemByName(); break;

case "8": HandleSortContainer(); break;

case "9": HandleRemoveElementByIndex(); break;

case "q":

Console.ForegroundColor = ConsoleColor.Yellow;

Console.WriteLine("Exiting...");

Console.ResetColor();

return;

default:

Console.ForegroundColor = ConsoleColor.Red;

Console.WriteLine("Invalid choice. Please try again.");

Console.ResetColor();

break;

}

}

catch (ValueLessThanZero ex)

{

PrintErrorMessage($"Input/Validation Error: {ex.Message}");

}

catch (FormatException ex)

{

PrintErrorMessage($"Input Format Error: Invalid format entered. {ex.Message}");

}

catch (IndexOutOfRangeException ex)

{

PrintErrorMessage($"Error: Index out of range. {ex.Message}");

}

catch (KeyNotFoundException ex)

{

PrintErrorMessage($"Error: Key (e.g., Insertion ID) not found. {ex.Message}");

}

catch (ArgumentException ex)

{

PrintErrorMessage($"Argument Error: {ex.Message}");

}

catch (TargetInvocationException ex)

{

Exception inner = ex.InnerException ?? ex;

while (inner.InnerException != null) { inner = inner.InnerException; }

PrintErrorMessage($"Error during operation: {inner.GetType().Name} - {inner.Message}");

}

catch (Exception ex)

{

PrintErrorMessage($"An unexpected error occurred: {ex.GetType().Name} - {ex.Message}");

}

finally

{

Console.ResetColor();

}

}

}

// --- Menu Printing ---

static void PrintMenu()

{

Console.ForegroundColor = ConsoleColor.Green;

Console.WriteLine("\n------ Menu ------");

Console.ForegroundColor = ConsoleColor.DarkGray;

Console.WriteLine($"Active Container: {activeContainerType}");

Console.ForegroundColor = ConsoleColor.Cyan;

Console.WriteLine("1. Automatic Generation (Select/Switch Container)");

Console.WriteLine("2. Manual Input (Select/Switch Container)");

Console.WriteLine("3. Show Active Container");

Console.ForegroundColor = ConsoleColor.White;

Console.WriteLine("#. --- ### ### ### ---");

Console.ForegroundColor = ConsoleColor.Cyan;

Console.WriteLine("4. Get Element by Insertion ID (1-based)");

Console.WriteLine("5. Get Elements by Name");

// Console.WriteLine("6. Get Elements by Price");

Console.ForegroundColor = ConsoleColor.White;

Console.WriteLine("#. --- ### ### ### ---");

Console.ForegroundColor = ConsoleColor.Cyan;

Console.WriteLine("6. Change Item by Insertion ID (1-based)");

Console.WriteLine("7. Change Item by Name");

Console.ForegroundColor = ConsoleColor.White;

Console.WriteLine("#. --- ### ### ### ---");

Console.ForegroundColor = ConsoleColor.Cyan;

Console.WriteLine("8. Sort Active Container by Price");

Console.WriteLine("9. Remove Element by Current Index (0-based)");

Console.ForegroundColor = ConsoleColor.White;

Console.WriteLine("#. --- ### ### ### ---");

Console.ForegroundColor = ConsoleColor.Cyan;

Console.WriteLine("q. Exit");

Console.ForegroundColor = ConsoleColor.Yellow;

Console.Write("Enter your choice: ");

Console.ResetColor();

}

static void PrintErrorMessage(string message)

{

Console.ForegroundColor = ConsoleColor.Red;

Console.WriteLine($"\nERROR: {message}");

Console.ResetColor();

}

// --- Container Selection Logic ---

static void HandleContainerSelectionAndAction(Action actionToPerform)

{

ContainerType chosenType = AskContainerType();

if (chosenType == ContainerType.None)

{

Console.ForegroundColor = ConsoleColor.Yellow;

Console.WriteLine("Operation cancelled.");

Console.ResetColor();

return;

}

if (activeContainerType != chosenType || (activeContainerType == ContainerType.None))

{

bool switchConfirmed = true;

if (activeContainerType != ContainerType.None && activeContainerType != chosenType)

{

Console.ForegroundColor = ConsoleColor.Yellow;

Console.Write($"Switching to {chosenType} container will clear the current {activeContainerType} container. Continue? (y/n): ");

Console.ResetColor();

switchConfirmed = (Console.ReadLine()?.Trim().ToLower() == "y");

}

if (switchConfirmed)

{

Console.ForegroundColor = ConsoleColor.Magenta;

Console.WriteLine($"\nInitializing {chosenType} container...");

Console.ResetColor();

containerArray = null;

containerList = null;

activeContainerType = chosenType;

if (activeContainerType == ContainerType.Array)

{

containerArray = new Container<IName>();

}

else // LinkedList

{

containerList = new ContainerLinkedList<IName>();

}

}

else

{

Console.ForegroundColor = ConsoleColor.Yellow;

Console.WriteLine("Switch cancelled. Keeping the current container.");

Console.ResetColor();

return;

}

}

else

{

Console.ForegroundColor = ConsoleColor.Green;

Console.WriteLine($"\nContinuing with the active {activeContainerType} container.");

Console.ResetColor();

}

actionToPerform();

}

static ContainerType AskContainerType()

{

Console.ForegroundColor = ConsoleColor.Yellow;

Console.WriteLine("\nSelect Container Type:");

Console.ForegroundColor = ConsoleColor.Cyan;

Console.WriteLine("1. Array-based Container");

Console.WriteLine("2. Linked List Container");

Console.ForegroundColor = ConsoleColor.Yellow;

Console.Write("Enter choice (1 or 2, or any other key to cancel): ");

Console.ResetColor();

string choice = Console.ReadLine() ?? "";

return choice switch

{

"1" => ContainerType.Array,

"2" => ContainerType.LinkedList,

\_ => ContainerType.None,

};

}

// --- Action Handlers ---

static void HandleAutomaticGeneration()

{

Console.ForegroundColor = ConsoleColor.Green;

Console.WriteLine("\n--- Automatic Generation ---");

Console.ResetColor();

Console.Write("Enter number of elements to generate: ");

if (int.TryParse(Console.ReadLine(), out int count) && count > 0)

{

if (activeContainerType == ContainerType.Array)

{

AutomaticGenerationArray(containerArray!, random, count);

DemonstrateIndexersArray(containerArray!, random);

}

else // LinkedList

{

AutomaticGenerationList(containerList!, random, count);

DemonstrateIndexersList(containerList!, random);

}

Console.ForegroundColor = ConsoleColor.Green;

Console.WriteLine($"\nAutomatic generation of {count} elements complete for {activeContainerType} container.");

Console.ResetColor();

}

else

{

PrintErrorMessage("Invalid input for count (must be a positive integer). Generation cancelled.");

}

}

static void HandleManualInput()

{

Console.ForegroundColor = ConsoleColor.Green;

Console.WriteLine($"\n--- Manual Input for {activeContainerType} Container ---");

Console.ResetColor();

if (activeContainerType == ContainerType.Array)

{

ManualInputArray(containerArray!);

}

else // LinkedList

{

ManualInputList(containerList!);

}

}

static void HandleShowContainer()

{

Console.ForegroundColor = ConsoleColor.Green;

Console.WriteLine($"\n--- Show {activeContainerType} Container ---");

Console.ResetColor();

if (IsContainerEmpty(out int currentCount))

{

// Message printed by IsContainerEmpty

return;

}

if (activeContainerType == ContainerType.Array)

{

ShowContainerArray(containerArray!, currentCount);

}

else // LinkedList

{

ShowContainerList(containerList!, currentCount);

}

}

// Still gets by Insertion ID, displays current index

static void HandleGetElementByInsertionId()

{

Console.ForegroundColor = ConsoleColor.Green;

Console.WriteLine($"\n--- Get Element by Insertion ID from {activeContainerType} Container ---");

Console.ResetColor();

if (IsContainerEmpty(out \_)) return;

int maxId = GetNextInsertionId();

if (maxId == 0)

{

PrintErrorMessage("Container is empty, no IDs to get.");

return;

}

Console.ForegroundColor = ConsoleColor.Yellow;

Console.Write($"Enter insertion ID (1 to {maxId}): ");

Console.ResetColor();

if (int.TryParse(Console.ReadLine(), out int inputId) && inputId >= 1 && inputId <= maxId)

{

int insertionId = inputId - 1;

IName? item = null;

try

{

if (activeContainerType == ContainerType.Array)

{

item = containerArray![insertionId];

}

else // LinkedList

{

item = containerList![insertionId];

}

}

catch (IndexOutOfRangeException)

{

PrintErrorMessage($"Item with insertion ID {inputId} not found or invalid for container structure.");

return;

}

catch (Exception ex)

{

PrintErrorMessage($"Error accessing item with insertion ID {inputId}: {ex.Message}");

return;

}

if (item == null)

{

PrintErrorMessage($"Item with insertion ID {inputId} not found (possibly removed or ID never used/valid).");

return;

}

int currentIndex = FindIndexByReference(item);

if (currentIndex == -1)

{

PrintErrorMessage($"Found item by insertion ID {inputId}, but could not determine its current index for display.");

return;

}

Console.ForegroundColor = ConsoleColor.Green;

Console.WriteLine($"\nItem Details (Insertion ID: {inputId}, Current Index: {currentIndex}):");

Console.ResetColor();

DisplayItemTable(currentIndex + 1, item);

}

else

{

PrintErrorMessage($"Invalid input. Please enter a valid integer ID between 1 and {maxId}.");

}

}

static void HandleGetElementByName()

{

Console.ForegroundColor = ConsoleColor.Green;

Console.WriteLine($"\n--- Get Elements by Name from {activeContainerType} Container ---");

Console.ResetColor();

if (IsContainerEmpty(out \_)) return;

Console.ForegroundColor = ConsoleColor.Yellow;

Console.Write("Enter the Name to search for: ");

Console.ResetColor();

string name = Console.ReadLine() ?? "";

if (string.IsNullOrWhiteSpace(name))

{

PrintErrorMessage("Invalid input. Name cannot be empty.");

return;

}

List<IName> itemsFoundList = new List<IName>();

if (activeContainerType == ContainerType.Array)

{

IName[]? itemsFoundArray = containerArray![name];

if (itemsFoundArray != null)

{

itemsFoundList.AddRange(itemsFoundArray.Where(i => i != null)!);

}

}

else // LinkedList

{

List<IName>? itemsFoundLinkedList = containerList![name];

if (itemsFoundLinkedList != null)

{

itemsFoundList.AddRange(itemsFoundLinkedList);

}

}

if (itemsFoundList.Count > 0)

{

Console.ForegroundColor = ConsoleColor.Green;

Console.WriteLine($"\nFound {itemsFoundList.Count} element(s) with Name '{name}':");

Console.ResetColor();

int tableWidth = CalculateTableWidth();

PrintTableHeader(tableWidth);

foreach (var foundItem in itemsFoundList)

{

int currentIndex = FindIndexByReference(foundItem);

if (currentIndex != -1)

{

WriteDataRowByDisplayId(currentIndex + 1, foundItem, tableWidth);

}

else

{

// Item was found by name indexer but couldn't be located by reference

Console.ForegroundColor = ConsoleColor.Yellow;

string itemStr = foundItem.ToString() ?? "N/A";

Console.WriteLine($"|{PadAndCenter($"Warning: Could not determine current index for item '{itemStr.Substring(0, Math.Min(20, itemStr.Length))}...'", tableWidth - 2)}|");

Console.ResetColor();

}

DrawHorizontalLine(tableWidth);

}

}

else

{

Console.ForegroundColor = ConsoleColor.Yellow;

Console.WriteLine($"No elements found with Name '{name}'.");

Console.ResetColor();

}

}

// Still changes by Insertion ID, displays current id

static void HandleChangeItemByInsertionId()

{

Console.ForegroundColor = ConsoleColor.Green;

Console.WriteLine($"\n--- Change Item by Insertion ID in {activeContainerType} Container ---");

Console.ResetColor();

if (IsContainerEmpty(out \_)) return;

int maxId = GetNextInsertionId();

if (maxId == 0)

{

PrintErrorMessage("Container is empty, no IDs to modify.");

return;

}

Console.ForegroundColor = ConsoleColor.Yellow;

Console.Write($"Enter item insertion ID to modify (1 to {maxId}): ");

Console.ResetColor();

if (int.TryParse(Console.ReadLine(), out int inputId) && inputId >= 1 && inputId <= maxId)

{

int insertionId = inputId - 1;

IName? itemToModify = null;

try

{

if (activeContainerType == ContainerType.Array)

{

itemToModify = containerArray![insertionId];

}

else // LinkedList

{

itemToModify = containerList![insertionId];

}

}

catch (IndexOutOfRangeException)

{

PrintErrorMessage($"Item with insertion ID {inputId} not found or invalid for container structure.");

return;

}

catch (Exception ex)

{

PrintErrorMessage($"Error accessing item with insertion ID {inputId}: {ex.Message}");

return;

}

if (itemToModify == null)

{

PrintErrorMessage($"Item with insertion ID {inputId} not found (possibly removed or ID never used/valid).");

return;

}

int currentIndex = FindIndexByReference(itemToModify);

if (currentIndex == -1)

{

PrintErrorMessage($"Found item by insertion ID {inputId}, but could not determine its current index for display.");

return;

}

Console.ForegroundColor = ConsoleColor.Green;

Console.WriteLine("\nCurrent item details:");

Console.ResetColor();

DisplayItemTable(currentIndex + 1, itemToModify);

ModifyProperty(itemToModify, insertionId);

}

else

{

PrintErrorMessage($"Invalid input. Please enter a valid integer ID between 1 and {maxId}.");

}

}

static void HandleChangeItemByName()

{

Console.ForegroundColor = ConsoleColor.Green;

Console.WriteLine($"\n--- Change Item by Name in {activeContainerType} Container ---");

Console.ResetColor();

if (IsContainerEmpty(out \_)) return;

Console.ForegroundColor = ConsoleColor.Yellow;

Console.Write("Enter the Name of the item(s) to modify: ");

Console.ResetColor();

string name = Console.ReadLine() ?? "";

if (string.IsNullOrWhiteSpace(name))

{

PrintErrorMessage("Invalid input. Name cannot be empty.");

return;

}

List<IName> validItems = new List<IName>();

if (activeContainerType == ContainerType.Array)

{

IName[]? itemsFoundArray = containerArray![name];

if (itemsFoundArray != null) validItems.AddRange(itemsFoundArray.Where(i => i != null)!);

}

else // LinkedList

{

List<IName>? itemsFoundList = containerList![name];

if (itemsFoundList != null) validItems.AddRange(itemsFoundList);

}

if (validItems.Count == 0)

{

Console.ForegroundColor = ConsoleColor.Yellow;

Console.WriteLine($"No valid elements found matching Name '{name}'.");

Console.ResetColor();

return;

}

IName itemToModify;

int itemInsertionId = -1;

int currentDisplayIndex = -1;

if (validItems.Count == 1)

{

itemToModify = validItems[0];

itemInsertionId = GetInsertionIdForItem(itemToModify);

currentDisplayIndex = FindIndexByReference(itemToModify);

if (itemInsertionId == -1 || currentDisplayIndex == -1) { PrintErrorMessage("Could not find ID or index for the item."); return; }

Console.ForegroundColor = ConsoleColor.Green;

Console.WriteLine($"\nFound one item (Current Index: {currentDisplayIndex + 1}, Insertion ID: {itemInsertionId + 1}):");

Console.ResetColor();

}

else // Multiple items found

{

Console.ForegroundColor = ConsoleColor.Green;

Console.WriteLine($"\nFound {validItems.Count} items with Name '{name}'. Please choose which one to modify:");

Console.ResetColor();

Dictionary<int, int> choiceToCurrentIndexMap = new Dictionary<int, int>();

for (int i = 0; i < validItems.Count; i++)

{

int currentItemIndex = FindIndexByReference(validItems[i]);

if (currentItemIndex != -1)

{

string itemInfo = validItems[i].ToString() ?? "N/A";

Console.WriteLine($"{i + 1}. (Index: {currentItemIndex + 1}) {itemInfo}");

choiceToCurrentIndexMap[i + 1] = currentItemIndex;

}

else

{

Console.ForegroundColor = ConsoleColor.Yellow;

string itemStr = validItems[i].ToString() ?? "N/A";

Console.WriteLine($"{i + 1}. (Index: ???) Could not map item - {itemStr}");

Console.ResetColor();

}

}

Console.ForegroundColor = ConsoleColor.Yellow;

Console.Write($"Enter choice (1 to {validItems.Count}): ");

Console.ResetColor();

if (int.TryParse(Console.ReadLine(), out int choice)

&& choice >= 1 && choice <= validItems.Count

&& choiceToCurrentIndexMap.TryGetValue(choice, out int chosenCurrentIndex))

{

itemToModify = GetItemByCurrentIndex(chosenCurrentIndex);

if (itemToModify == null) { PrintErrorMessage("Failed to re-acquire selected item by current index."); return; }

itemInsertionId = GetInsertionIdForItem(itemToModify);

currentDisplayIndex = chosenCurrentIndex;

if (itemInsertionId == -1) { PrintErrorMessage("Could not determine insertion ID for the chosen item."); return; }

}

else

{

PrintErrorMessage("Invalid choice or item mapping failed.");

return;

}

Console.ForegroundColor = ConsoleColor.Green;

Console.WriteLine($"\nSelected item (Current Index: {currentDisplayIndex + 1}, Insertion ID: {itemInsertionId + 1}):");

Console.ResetColor();

}

// Modify the selected item

if (currentDisplayIndex != -1 && itemToModify != null)

{

DisplayItemTable(currentDisplayIndex + 1, itemToModify);

ModifyProperty(itemToModify, itemInsertionId);

}

else

{

Console.ForegroundColor = ConsoleColor.Yellow;

Console.WriteLine("\nCould not reliably identify the selected item or its index. Modification cancelled.");

Console.WriteLine(itemToModify?.ToString() ?? "N/A");

Console.ResetColor();

}

}

static void HandleSortContainer()

{

Console.ForegroundColor = ConsoleColor.Green;

Console.WriteLine($"\n--- Sorting {activeContainerType} Container by Price ---");

Console.ResetColor();

if (IsContainerEmpty(out int currentCount)) return;

if (currentCount > 0)

{

if (activeContainerType == ContainerType.Array)

{

containerArray!.Sort();

}

else // LinkedList

{

containerList!.Sort("Price");

}

Console.ForegroundColor = ConsoleColor.Green;

Console.WriteLine("Container sorted.");

Console.ResetColor();

HandleShowContainer();

}

}

static void HandleRemoveElementByIndex()

{

Console.ForegroundColor = ConsoleColor.Green;

Console.WriteLine($"\n--- Remove Element by Current Index from {activeContainerType} Container ---");

Console.ResetColor();

if (IsContainerEmpty(out int currentCount)) return;

Console.ForegroundColor = ConsoleColor.Yellow;

Console.Write($"Enter element index to remove (0 to {currentCount - 1}): ");

Console.ResetColor();

if (int.TryParse(Console.ReadLine(), out int index) && index >= 0 && index < currentCount)

{

IName? removedItem = null;

int removedItemInsertionId = -1;

try

{

IName? itemToRemove = GetItemByCurrentIndex(index);

if (itemToRemove != null)

{

removedItemInsertionId = GetInsertionIdForItem(itemToRemove);

}

else

{

PrintErrorMessage($"Could not retrieve item at index {index} before removal.");

}

if (activeContainerType == ContainerType.Array)

{

removedItem = containerArray!.RemoveById(index);

}

else // LinkedList

{

removedItem = containerList!.RemoveByIndex(index);

}

if (removedItem != null)

{

Console.ForegroundColor = ConsoleColor.DarkCyan;

string idString = removedItemInsertionId != -1 ? $"(original Insertion ID: {removedItemInsertionId + 1})" : "(original Insertion ID unknown)";

Console.WriteLine($"\nElement at index {index} {idString} was removed:");

Console.WriteLine(removedItem.ToString() ?? "Removed item details unavailable.");

Console.ResetColor();

}

else

{

PrintErrorMessage($"Error: Failed to remove item at index {index}. Item might have been null unexpectedly or removal failed.");

}

}

catch (Exception ex)

{

PrintErrorMessage($"Error during removal at index {index}: {ex.Message}");

}

}

else

{

PrintErrorMessage($"Invalid input. Please enter a valid index between 0 and {currentCount - 1}.");

}

}

// --- Indexer Interaction Methods ---

// Array Container Indexer Demonstration

static void DemonstrateIndexersArray(Container<IName> container, Random random)

{

Console.ForegroundColor = ConsoleColor.Yellow;

Console.WriteLine("\n--- Demonstrating Array Container Indexer Usage ---");

Console.ResetColor();

if (container.IsEmpty(false)) return;

int currentCount = container.GetCount();

int nextId = container.GetInsertionId();

// 1. Demonstrate Insertion ID Indexer (Get)

if (nextId > 0)

{

int demoInsertionId = random.Next(nextId);

Console.WriteLine($"1. Accessing item by random insertion ID [{demoInsertionId + 1}]:");

try

{

IName? itemById = container[demoInsertionId];

if (itemById != null)

{

int currentIndex = FindIndexByReference(itemById);

string indexStr = currentIndex != -1 ? $"(Current Index: {currentIndex + 1})" : "";

Console.ForegroundColor = ConsoleColor.Cyan;

Console.WriteLine($" Found {indexStr}: {itemById.ToString() ?? "N/A"}");

Console.ResetColor();

}

else

{

Console.ForegroundColor = ConsoleColor.Yellow;

Console.WriteLine($" Item with insertion ID {demoInsertionId + 1} not found (likely removed or ID never used/valid).");

Console.ResetColor();

}

}

catch (Exception ex)

{

PrintErrorMessage($" Error getting item by insertion ID {demoInsertionId + 1}: {ex.Message}");

}

}

else

{

Console.WriteLine("1. No items added yet, cannot demonstrate insertion ID indexer.");

}

// 2. Demonstrate Name Indexer (Get)

string? demoName = FindDemoName(container.GetItems(), container.GetCount(), random);

Console.WriteLine($"\n2. Using string indexer container[\"{demoName ?? "N/A"}\"]:");

if (!string.IsNullOrWhiteSpace(demoName))

{

try

{

IName[]? itemsByName = container[demoName];

if (itemsByName != null && itemsByName.Any(i => i != null))

{

Console.ForegroundColor = ConsoleColor.Cyan;

Console.WriteLine($" Found {itemsByName.Count(i => i != null)} item(s):");

foreach (var item in itemsByName.Where(i => i != null))

{

int currentIndex = FindIndexByReference(item!);

string indexStr = currentIndex != -1 ? $"(Index: {currentIndex + 1})" : "";

Console.WriteLine($" - {indexStr} {item!.ToString() ?? "N/A"}");

}

Console.ResetColor();

}

else

{

Console.ForegroundColor = ConsoleColor.Yellow;

Console.WriteLine($" No items found for name '{demoName}'.");

Console.ResetColor();

}

}

catch (Exception ex)

{

PrintErrorMessage($" Error getting item(s) by name '{demoName}': {ex.Message}");

}

}

else

{

Console.ForegroundColor = ConsoleColor.Yellow;

Console.WriteLine(" Could not find an item with a non-empty name in the sample to demonstrate.");

Console.ResetColor();

}

// 3. Demonstrate Insertion ID Indexer (Set)

int validDemoId = FindValidInsertionId(container);

if (validDemoId != -1)

{

Console.WriteLine($"\n3. Attempting to change item with insertion ID [{validDemoId + 1}] using property modification:");

IName? itemToModify = container[validDemoId];

if (itemToModify != null)

{

int currentIndex = FindIndexByReference(itemToModify);

string indexStr = currentIndex != -1 ? $"(Current Index: {currentIndex + 1})" : "";

Console.ForegroundColor = ConsoleColor.Magenta;

Console.WriteLine($" Original Item {indexStr}: '{itemToModify.ToString() ?? "N/A"}'");

Console.ResetColor();

try

{

string newName = $"ChangedItem-{validDemoId + 1}";

Console.WriteLine($" Attempting to set Name to '{newName}'...");

itemToModify.GetType().GetProperty("Name")?.SetValue(itemToModify, newName);

Console.ForegroundColor = ConsoleColor.Green;

Console.WriteLine($" Property 'Name' potentially updated (check via Show Container).");

IName? changedItem = container[validDemoId];

int changedIndex = changedItem != null ? FindIndexByReference(changedItem) : -1;

string changedIndexStr = changedIndex != -1 ? $"(Current Index: {changedIndex + 1})" : "";

Console.ForegroundColor = ConsoleColor.Cyan;

Console.WriteLine($" Current value {changedIndexStr}: {changedItem?.ToString() ?? "Not Found!"}");

Console.ResetColor();

}

catch (TargetInvocationException tie) { PrintErrorMessage($" Error modifying property: {tie.InnerException?.Message ?? tie.Message}"); }

catch (Exception ex) { PrintErrorMessage($" Error modifying property: {ex.Message}"); }

}

else { Console.WriteLine($" Could not retrieve item with insertion ID {validDemoId + 1} for modification demonstration."); }

}

else

{

Console.WriteLine("\n3. Cannot demonstrate modification: No suitable item found with a valid insertion ID.");

}

Console.ForegroundColor = ConsoleColor.Yellow;

Console.WriteLine("--- End Array Indexer Demonstration ---");

Console.ResetColor();

}

// LinkedList Container Indexer Demonstration

static void DemonstrateIndexersList(ContainerLinkedList<IName> container, Random random)

{

Console.ForegroundColor = ConsoleColor.Yellow;

Console.WriteLine("\n--- Demonstrating LinkedList Container Indexer Usage ---");

Console.ResetColor();

if (container.Count == 0) return;

List<int> currentInsertionOrder = container.GetInsertionOrder();

if (currentInsertionOrder.Count == 0)

{

Console.WriteLine("Container has items but insertion order list is empty (unexpected). Cannot demonstrate.");

return;

}

// 1. Demonstrate Insertion ID Indexer (Get)

int randomIndexList = random.Next(currentInsertionOrder.Count);

int demoInsertionIdList = currentInsertionOrder[randomIndexList];

Console.WriteLine($"1. Accessing item by existing insertion ID [{demoInsertionIdList + 1}]:");

try

{

IName? itemById = container[demoInsertionIdList];

if (itemById != null)

{

int currentIndex = FindIndexByReference(itemById);

string indexStr = currentIndex != -1 ? $"(Current Index: {currentIndex + 1})" : "";

Console.ForegroundColor = ConsoleColor.Cyan;

Console.WriteLine($" Found {indexStr}: {itemById.ToString() ?? "N/A"}");

Console.ResetColor();

}

else

{

Console.ForegroundColor = ConsoleColor.Yellow;

Console.WriteLine($" Item with insertion ID {demoInsertionIdList + 1} not found (unexpected).");

Console.ResetColor();

}

}

catch (Exception ex)

{

PrintErrorMessage($" Error getting item by insertion ID {demoInsertionIdList + 1}: {ex.Message}");

}

// 2. Demonstrate Name Indexer (Get)

string? demoName = FindDemoName(container, random);

Console.WriteLine($"\n2. Using string indexer container[\"{demoName ?? "N/A"}\"]:");

if (!string.IsNullOrWhiteSpace(demoName))

{

try

{

List<IName>? itemsByName = container[demoName];

if (itemsByName != null && itemsByName.Count > 0)

{

Console.ForegroundColor = ConsoleColor.Cyan;

Console.WriteLine($" Found {itemsByName.Count} item(s):");

foreach (var item in itemsByName)

{

int currentIndex = FindIndexByReference(item);

string indexStr = currentIndex != -1 ? $"(Index: {currentIndex + 1})" : "";

Console.WriteLine($" - {indexStr} {item.ToString() ?? "N/A"}");

}

Console.ResetColor();

}

else

{

Console.ForegroundColor = ConsoleColor.Yellow;

Console.WriteLine($" No items found for name '{demoName}'.");

Console.ResetColor();

}

}

catch (Exception ex)

{

PrintErrorMessage($" Error getting item(s) by name '{demoName}': {ex.Message}");

}

}

else

{

Console.ForegroundColor = ConsoleColor.Yellow;

Console.WriteLine(" Could not find an item with a non-empty name in the sample to demonstrate.");

Console.ResetColor();

}

// 3. Demonstrate Insertion ID Indexer (Set)

int validDemoIdList = FindValidInsertionId(container);

if (validDemoIdList != -1)

{

Console.WriteLine($"\n3. Attempting to change item with insertion ID [{validDemoIdList + 1}] using property modification:");

IName? itemToModify = container[validDemoIdList];

if (itemToModify != null)

{

int currentIndex = FindIndexByReference(itemToModify);

string indexStr = currentIndex != -1 ? $"(Current Index: {currentIndex + 1})" : "";

Console.ForegroundColor = ConsoleColor.Magenta;

Console.WriteLine($" Original Item {indexStr}: '{itemToModify.ToString() ?? "N/A"}'");

Console.ResetColor();

try

{

string newName = $"ChangedItem-{validDemoIdList + 1}";

Console.WriteLine($" Attempting to set Name to '{newName}'...");

itemToModify.GetType().GetProperty("Name")?.SetValue(itemToModify, newName);

Console.ForegroundColor = ConsoleColor.Green;

Console.WriteLine($" Property 'Name' potentially updated (check via Show Container).");

IName? changedItem = container[validDemoIdList];

int changedIndex = changedItem != null ? FindIndexByReference(changedItem) : -1;

string changedIndexStr = changedIndex != -1 ? $"(Current Index: {changedIndex + 1})" : "";

Console.ForegroundColor = ConsoleColor.Cyan;

Console.WriteLine($" Current value {changedIndexStr}: {changedItem?.ToString() ?? "Not Found!"}");

Console.ResetColor();

}

catch (TargetInvocationException tie) { PrintErrorMessage($" Error modifying property: {tie.InnerException?.Message ?? tie.Message}"); }

catch (Exception ex) { PrintErrorMessage($" Error modifying property: {ex.Message}"); }

}

else { Console.WriteLine($" Could not retrieve item with insertion ID {validDemoIdList + 1} for modification demonstration."); }

}

else

{

Console.WriteLine("\n3. Cannot demonstrate modification: No suitable item found with a valid insertion ID.");

}

Console.ForegroundColor = ConsoleColor.Yellow;

Console.WriteLine("--- End LinkedList Indexer Demonstration ---");

Console.ResetColor();

}

static string? FindDemoName(IName?[] items, int count, Random random)

{

string? demoName = null;

if (count > 0)

{

for (int i = 0; i < 5; ++i)

{

int randomIndex = random.Next(count);

IName? sourceItemForName = items[randomIndex];

demoName = GetPropertyValue<string>(sourceItemForName, "Name");

if (!string.IsNullOrWhiteSpace(demoName)) break;

}

}

return demoName;

}

static string? FindDemoName(ContainerLinkedList<IName> listContainer, Random random)

{

string? demoName = null;

if (listContainer.Count > 0)

{

for (int i = 0; i < 5; ++i)

{

int randomIndex = random.Next(listContainer.Count);

var node = listContainer.First;

int currentIndex = 0;

while (node != null && currentIndex < randomIndex)

{

node = node.Next;

currentIndex++;

}

if (node != null)

{

demoName = GetPropertyValue<string>(node.Data, "Name");

if (!string.IsNullOrWhiteSpace(demoName)) break;

}

}

}

return demoName;

}

static int FindValidInsertionId(Container<IName> container)

{

int nextId = container.GetInsertionId();

if (nextId <= 0) return -1;

for (int id = nextId - 1; id >= 0; id--)

{

try

{

if (container[id] != null) return id;

}

catch (IndexOutOfRangeException) { /\* Ignore \*/ }

catch (Exception ex) { System.Diagnostics.Debug.WriteLine($"Debug: Error checking ID {id} in FindValidInsertionId (Array): {ex.Message}"); }

}

return -1;

}

static int FindValidInsertionId(ContainerLinkedList<IName> container)

{

List<int> order = container.GetInsertionOrder();

if (container.Count == 0 || order.Count == 0) return -1;

// Return the last added insertion ID (0-based)

return order[order.Count - 1];

}

// --- Property Modification Logic ---

static void ModifyProperty(object itemToModify, int itemInsertionId)

{

ArgumentNullException.ThrowIfNull(itemToModify);

var properties = itemToModify.GetType()

.GetProperties(BindingFlags.Public | BindingFlags.Instance)

.Where(p => p.CanWrite && p.GetSetMethod(true) != null)

.ToList();

if (properties.Count == 0)

{

Console.ForegroundColor = ConsoleColor.Yellow;

Console.WriteLine("This object has no publicly writable properties.");

Console.ResetColor();

return;

}

Console.ForegroundColor = ConsoleColor.Green;

Console.WriteLine("\nChoose property to modify:");

Console.ResetColor();

for (int i = 0; i < properties.Count; i++)

{

object? currentValue = "?";

try { currentValue = properties[i].GetValue(itemToModify); } catch { /\* Ignore \*/ }

Console.ForegroundColor = ConsoleColor.Cyan;

Console.WriteLine($"{i + 1}. {properties[i].Name} (Type: {properties[i].PropertyType.Name}, Current: '{currentValue ?? "null"}')");

Console.ResetColor();

}

Console.ForegroundColor = ConsoleColor.Yellow;

Console.Write($"Enter choice (1 to {properties.Count}): ");

Console.ResetColor();

if (int.TryParse(Console.ReadLine(), out int propChoice) && propChoice >= 1 && propChoice <= properties.Count)

{

PropertyInfo selectedProperty = properties[propChoice - 1];

Type propertyType = selectedProperty.PropertyType;

Type underlyingType = Nullable.GetUnderlyingType(propertyType);

bool isNullable = underlyingType != null;

Type targetType = underlyingType ?? propertyType;

Console.ForegroundColor = ConsoleColor.Yellow;

Console.Write($"Enter new value for {selectedProperty.Name} (Type: {targetType.Name}{(isNullable ? ", or empty for null" : "")}): ");

Console.ResetColor();

string newValueString = Console.ReadLine() ?? "";

object? convertedValue;

if (!TryParseValue(newValueString, targetType, isNullable, out convertedValue))

{

return;

}

try

{

selectedProperty.SetValue(itemToModify, convertedValue, null);

Console.ForegroundColor = ConsoleColor.Green;

Console.WriteLine($"\nProperty '{selectedProperty.Name}' updated successfully for item (Insertion ID: {itemInsertionId + 1}).");

Console.WriteLine("New item details:");

Console.ResetColor();

int currentIndex = FindIndexByReference((IName)itemToModify);

if (currentIndex != -1)

{

DisplayItemTable(currentIndex + 1, (IName)itemToModify);

}

else

{

PrintErrorMessage("Could not determine current index after modification for display.");

}

}

catch (TargetInvocationException tie)

{

PrintErrorMessage($"Validation Error setting property '{selectedProperty.Name}': {tie.InnerException?.Message ?? tie.Message}");

}

catch (ArgumentException argEx)

{

PrintErrorMessage($"Error setting property '{selectedProperty.Name}': Type mismatch or invalid argument. {argEx.Message}");

}

catch (Exception ex)

{

PrintErrorMessage($"Unexpected error setting property '{selectedProperty.Name}': {ex.Message}");

}

}

else

{

PrintErrorMessage("Invalid property choice.");

}

}

static bool TryParseValue(string input, Type targetType, bool isNullable, out object? parsedValue)

{

parsedValue = null;

if (isNullable && string.IsNullOrEmpty(input))

{

return true;

}

try

{

if (targetType == typeof(bool))

{

string lowerVal = input.Trim().ToLowerInvariant();

if (lowerVal == "true" || lowerVal == "1" || lowerVal == "yes" || lowerVal == "y")

parsedValue = true;

else if (lowerVal == "false" || lowerVal == "0" || lowerVal == "no" || lowerVal == "n")

parsedValue = false;

else

throw new FormatException($"Cannot convert '{input}' to Boolean.");

}

else

{

TypeConverter converter = TypeDescriptor.GetConverter(targetType);

if (converter != null && converter.CanConvertFrom(typeof(string)))

{

parsedValue = converter.ConvertFromString(null, CultureInfo.InvariantCulture, input);

}

else

{

parsedValue = Convert.ChangeType(input, targetType, CultureInfo.InvariantCulture);

}

}

return true;

}

catch (Exception ex) when (ex is FormatException || ex is InvalidCastException || ex is NotSupportedException || ex is ArgumentException)

{

PrintErrorMessage($"Conversion Error: Could not convert '{input}' to type {targetType.Name}. {ex.Message}");

return false;

}

}

// --- Automatic Generation ---

static void AutomaticGenerationArray(Container<IName> container, Random random, int count)

{

Console.WriteLine("Generating elements for Array Container...");

GenerateItems(count, random, item => container.Add(item));

Console.WriteLine("\nArray Generation process finished.");

}

static void AutomaticGenerationList(ContainerLinkedList<IName> container, Random random, int count)

{

Console.WriteLine("Generating elements for LinkedList Container...");

GenerateItems(count, random, item => container.AddLast(item));

Console.WriteLine("\nLinkedList Generation process finished.");

}

static void GenerateItems(int count, Random random, Action<IName> addAction)

{

for (int i = 0; i < count; i++)

{

IName newItem;

int typeChoice = random.Next(1, 9);

try

{

switch (typeChoice)

{

case 1: newItem = GenerateRandomProduct(random); break;

case 2: newItem = GenerateRandomRealEstate(random); break;

case 3: newItem = GenerateRandomRealEstateInvestment(random); break;

case 4: newItem = GenerateRandomApartment(random); break;

case 5: newItem = GenerateRandomHouse(random); break;

case 6: newItem = GenerateRandomHotel(random); break;

case 7: newItem = GenerateRandomLandPlot(random); break;

case 8: newItem = new RealEstate($"BaseRE{i}", random.Next(5000, 20000), $"Loc{i}", random.Next(50, 200), "Base"); break;

default: continue;

}

addAction(newItem);

Console.Write(".");

}

catch (Exception ex)

{

Console.Write("X");

System.Diagnostics.Debug.WriteLine($"\nGeneration Error: Failed to create item of type {typeChoice}. {ex.GetType().Name}: {ex.Message}");

}

}

}

// --- Manual Input ---

static void ManualInputArray(Container<IName> container)

{

IName? newItem = CreateItemManually();

if (newItem != null)

{

container.Add(newItem);

Console.ForegroundColor = ConsoleColor.Green;

Console.WriteLine($"{newItem.GetType().Name} added successfully to Array Container (Insertion ID: {container.GetInsertionId()}).");

Console.ResetColor();

}

}

static void ManualInputList(ContainerLinkedList<IName> container)

{

IName? newItem = CreateItemManually();

if (newItem != null)

{

container.AddLast(newItem);

Console.ForegroundColor = ConsoleColor.Green;

Console.WriteLine($"{newItem.GetType().Name} added successfully to LinkedList Container (Insertion ID: {container.GetNextInsertionId()}).");

Console.ResetColor();

}

}

static IName? CreateItemManually()

{

Console.ForegroundColor = ConsoleColor.Cyan;

Console.WriteLine("Choose class to create:");

Console.ForegroundColor = ConsoleColor.DarkCyan;

Console.WriteLine("1. Product");

Console.WriteLine("2. RealEstate");

Console.WriteLine("3. RealEstateInvestment");

Console.WriteLine("4. Apartment");

Console.WriteLine("5. House");

Console.WriteLine("6. Hotel");

Console.WriteLine("7. LandPlot");

Console.ForegroundColor = ConsoleColor.Yellow;

Console.Write("Enter choice: ");

Console.ResetColor();

string classChoice = Console.ReadLine() ?? "";

try

{

return classChoice switch

{

"1" => CreateManualProduct(),

"2" => CreateManualRealEstate(),

"3" => CreateManualRealEstateInvestment(),

"4" => CreateManualApartment(),

"5" => CreateManualHouse(),

"6" => CreateManualHotel(),

"7" => CreateManualLandPlot(),

\_ => throw new ArgumentException("Invalid class choice.")

};

}

catch (ValueLessThanZero ex) { PrintErrorMessage($"Creation Error: {ex.Message}"); return null; }

catch (FormatException ex) { PrintErrorMessage($"Invalid input format during creation: {ex.Message}"); return null; }

catch (ArgumentException ex) { PrintErrorMessage($"Invalid argument during creation: {ex.Message}"); return null; }

catch (Exception ex) { PrintErrorMessage($"Unexpected error during creation: {ex.Message}"); return null; }

}

// --- Container Display ---

static void ShowContainerArray(Container<IName> container, int currentCount)

{

string title = $"Array Container Contents ({currentCount} items)";

int tableWidth = CalculateTableWidth();

Console.ForegroundColor = ConsoleColor.Magenta;

Console.WriteLine(CenterString(title, tableWidth));

Console.ResetColor();

PrintTableHeader(tableWidth);

IName?[] items = container.GetItems();

for (int i = 0; i < currentCount; i++)

{

IName? item = items[i];

if (item == null) continue;

WriteDataRowByDisplayId(i + 1, item, tableWidth);

DrawHorizontalLine(tableWidth);

}

}

static void ShowContainerList(ContainerLinkedList<IName> container, int currentCount)

{

string title = $"LinkedList Container Contents ({currentCount} items)";

int tableWidth = CalculateTableWidth();

Console.ForegroundColor = ConsoleColor.Magenta;

Console.WriteLine(CenterString(title, tableWidth));

Console.ResetColor();

PrintTableHeader(tableWidth);

var node = container.First;

int i = 0;

while (node != null)

{

IName item = node.Data;

if (item != null)

{

WriteDataRowByDisplayId(i + 1, item, tableWidth);

DrawHorizontalLine(tableWidth);

}

node = node.Next;

i++;

}

}

// Displays item using 1-based current index

static void DisplayItemTable(int displayId, IName item)

{

if (item == null) return;

int tableWidth = CalculateTableWidth();

PrintTableHeader(tableWidth);

WriteDataRowByDisplayId(displayId, item, tableWidth);

DrawHorizontalLine(tableWidth);

}

// --- Table Formatting Helpers ---

const int idWidth = 6;

const int classWidth = 16;

const int nameWidth = 18;

const int priceWidth = 16;

const int locationWidth = 20;

const int sizeWidth = 10;

const int typeWidth = 14;

const int marketValueWidth = 18;

const int investmentTypeWidth = 18;

const int floorWidth = 7;

const int hoaWidth = 7;

const int gardenWidth = 9;

const int poolWidth = 6;

const int roomsWidth = 7;

const int starWidth = 6;

const int soilWidth = 10;

const int infraWidth = 7;

const int padding = 1;

const int numColumns = 17;

static int CalculateTableWidth()

{

int totalDataWidth = idWidth + classWidth + nameWidth + priceWidth + locationWidth + sizeWidth + typeWidth + marketValueWidth + investmentTypeWidth + floorWidth + hoaWidth + gardenWidth + poolWidth + roomsWidth + starWidth + soilWidth + infraWidth;

int totalPaddingWidth = numColumns \* padding;

return totalDataWidth + totalPaddingWidth;

}

static void PrintTableHeader(int tableWidth)

{

DrawHorizontalLine(tableWidth);

WriteHeaderRow();

DrawHorizontalLine(tableWidth);

}

static void WriteHeaderRow()

{

Console.ForegroundColor = ConsoleColor.Cyan;

Console.Write($"|{PadAndCenter("ID", idWidth)}");

Console.Write($"|{PadAndCenter("Class", classWidth)}");

Console.Write($"|{PadAndCenter("Name", nameWidth)}");

Console.Write($"|{PadAndCenter("Price", priceWidth)}");

Console.Write($"|{PadAndCenter("Location", locationWidth)}");

Console.Write($"|{PadAndCenter("Size", sizeWidth)}");

Console.Write($"|{PadAndCenter("Type", typeWidth)}");

Console.Write($"|{PadAndCenter("Mkt Value", marketValueWidth)}");

Console.Write($"|{PadAndCenter("Invest Type", investmentTypeWidth)}");

Console.Write($"|{PadAndCenter("Floor", floorWidth)}");

Console.Write($"|{PadAndCenter("HOA", hoaWidth)}");

Console.Write($"|{PadAndCenter("Garden", gardenWidth)}");

Console.Write($"|{PadAndCenter("Pool", poolWidth)}");

Console.Write($"|{PadAndCenter("Rooms", roomsWidth)}");

Console.Write($"|{PadAndCenter("Star", starWidth)}");

Console.Write($"|{PadAndCenter("Soil", soilWidth)}");

Console.Write($"|{PadAndCenter("Infra", infraWidth)}");

Console.WriteLine("|");

Console.ResetColor();

}

static void WriteDataRowByDisplayId(int displayId, object item, int tableWidth)

{

string FormatDecimal(decimal? d) => d?.ToString("N2", CultureInfo.InvariantCulture) ?? "-";

string FormatDouble(double? d) => d?.ToString("N1", CultureInfo.InvariantCulture) ?? "-";

string FormatBool(bool? b) => b.HasValue ? (b.Value ? "Yes" : "No") : "-";

string FormatInt(int? i) => i?.ToString() ?? "-";

string FormatString(string? s) => string.IsNullOrWhiteSpace(s) ? "-" : s;

Type itemType = item.GetType();

string name = FormatString(GetPropertyValue<string>(item, "Name"));

string fPrice = FormatDecimal(GetPropertyValue<decimal?>(item, "Price"));

string loc = FormatString(GetPropertyValue<string>(item, "Location"));

string fSize = FormatDouble(GetPropertyValue<double?>(item, "Size"));

string type = FormatString(GetPropertyValue<string>(item, "Type"));

string fMktVal = FormatDecimal(GetPropertyValue<decimal?>(item, "MarketValue"));

string invType = FormatString(GetPropertyValue<string>(item, "InvestmentType"));

string fFloor = FormatInt(GetPropertyValue<int?>(item, "FloorNumber"));

string fHoa = FormatDecimal(GetPropertyValue<decimal?>(item, "HOAFees"));

string fGarden = FormatDouble(GetPropertyValue<double?>(item, "GardenSize"));

string fPool = FormatBool(GetPropertyValue<bool?>(item, "Pool"));

string fRooms = FormatInt(GetPropertyValue<int?>(item, "Rooms"));

string fStar = FormatInt(GetPropertyValue<int?>(item, "StarRating"));

string soil = FormatString(GetPropertyValue<string>(item, "SoilType"));

string fInfra = FormatBool(GetPropertyValue<bool?>(item, "InfrastructureAccess"));

Console.Write($"|{PadAndCenter(displayId.ToString(), idWidth)}");

Console.Write($"|{PadAndCenter(itemType.Name, classWidth)}");

Console.Write($"|{PadAndCenter(name, nameWidth)}");

Console.Write($"|{PadAndCenter(fPrice, priceWidth)}");

Console.Write($"|{PadAndCenter(loc, locationWidth)}");

Console.Write($"|{PadAndCenter(fSize, sizeWidth)}");

Console.Write($"|{PadAndCenter(type, typeWidth)}");

Console.Write($"|{PadAndCenter(fMktVal, marketValueWidth)}");

Console.Write($"|{PadAndCenter(invType, investmentTypeWidth)}");

Console.Write($"|{PadAndCenter(fFloor, floorWidth)}");

Console.Write($"|{PadAndCenter(fHoa, hoaWidth)}");

Console.Write($"|{PadAndCenter(fGarden, gardenWidth)}");

Console.Write($"|{PadAndCenter(fPool, poolWidth)}");

Console.Write($"|{PadAndCenter(fRooms, roomsWidth)}");

Console.Write($"|{PadAndCenter(fStar, starWidth)}");

Console.Write($"|{PadAndCenter(soil, soilWidth)}");

Console.Write($"|{PadAndCenter(fInfra, infraWidth)}");

Console.WriteLine("|");

}

static void DrawHorizontalLine(int tableWidth)

{

Console.ForegroundColor = ConsoleColor.DarkGray;

Console.WriteLine(new string('-', tableWidth));

Console.ResetColor();

}

static string PadAndCenter(string? value, int totalWidth)

{

string val = value ?? "";

if (totalWidth <= 0) return "";

val = Truncate(val, totalWidth);

int spaces = totalWidth - val.Length;

int padLeft = spaces / 2;

return val.PadLeft(padLeft + val.Length).PadRight(totalWidth);

}

static string CenterString(string s, int width)

{

if (string.IsNullOrEmpty(s) || width <= 0) return new string(' ', Math.Max(0, width));

s = Truncate(s, width); // Ensure fits

int padding = Math.Max(0, (width - s.Length) / 2);

return new string(' ', padding) + s + new string(' ', Math.Max(0, width - s.Length - padding));

}

static string Truncate(string? value, int maxLength)

{

if (string.IsNullOrEmpty(value)) return "";

if (maxLength <= 0) return "";

if (value.Length <= maxLength) return value;

int subLength = Math.Max(0, maxLength - 3);

if (subLength == 0) return "...".Substring(0, Math.Min(3, maxLength));

return value.Substring(0, subLength) + "...";

}

// --- Reflection Property Getter ---

private static TValue? GetPropertyValue<TValue>(object? item, string propertyName)

{

if (item == null) return default;

PropertyInfo? property = item.GetType().GetProperty(propertyName, BindingFlags.Public | BindingFlags.Instance);

if (property != null && property.CanRead)

{

try

{

object? value = property.GetValue(item);

if (value == null) return default;

if (value is TValue correctlyTyped) return correctlyTyped;

Type? underlyingTValue = Nullable.GetUnderlyingType(typeof(TValue));

if (underlyingTValue != null && underlyingTValue == property.PropertyType)

{

try { return (TValue)Convert.ChangeType(value, underlyingTValue, CultureInfo.InvariantCulture); } catch { /\* Ignore \*/ }

}

if (typeof(TValue) == typeof(string))

{

try { return (TValue)(object)Convert.ToString(value, CultureInfo.InvariantCulture)!; } catch { /\* Ignore \*/ }

}

else if (typeof(TValue) == typeof(decimal) && IsNumericType(property.PropertyType))

{

try { return (TValue)(object)Convert.ToDecimal(value, CultureInfo.InvariantCulture); } catch { /\* Ignore \*/ }

}

else if (typeof(TValue) == typeof(double) && IsNumericType(property.PropertyType))

{

try { return (TValue)(object)Convert.ToDouble(value, CultureInfo.InvariantCulture); } catch { /\* Ignore \*/ }

}

else if (typeof(TValue) == typeof(int) && IsNumericType(property.PropertyType))

{

try { return (TValue)(object)Convert.ToInt32(value, CultureInfo.InvariantCulture); } catch { /\* Ignore \*/ }

}

else if (typeof(TValue) == typeof(bool))

{

if (IsNumericType(property.PropertyType))

{

try { return (TValue)(object)(Convert.ToDouble(value, CultureInfo.InvariantCulture) != 0); } catch { /\* Ignore \*/ }

}

else if (property.PropertyType == typeof(string))

{

if (bool.TryParse((string)value, out bool boolVal)) return (TValue)(object)boolVal;

}

}

try { return (TValue)Convert.ChangeType(value, typeof(TValue), CultureInfo.InvariantCulture); } catch { /\* Ignore \*/ }

}

catch (Exception ex)

{

System.Diagnostics.Debug.WriteLine($"Reflection Error getting '{propertyName}': {ex.Message}");

}

}

return default;

}

private static bool IsNumericType(Type type)

{

if (type == null) return false;

switch (Type.GetTypeCode(type))

{

case TypeCode.Byte:

case TypeCode.Decimal:

case TypeCode.Double:

case TypeCode.Int16:

case TypeCode.Int32:

case TypeCode.Int64:

case TypeCode.SByte:

case TypeCode.Single:

case TypeCode.UInt16:

case TypeCode.UInt32:

case TypeCode.UInt64:

return true;

default:

return false;

}

}

// --- Container State Helpers ---

static bool IsContainerEmpty(out int count)

{

count = 0;

bool isEmpty = true;

if (activeContainerType == ContainerType.Array && containerArray != null)

{

isEmpty = containerArray.IsEmpty(false);

count = containerArray.GetCount();

}

else if (activeContainerType == ContainerType.LinkedList && containerList != null)

{

count = containerList.Count;

isEmpty = (count == 0);

}

else

{

isEmpty = true;

}

if (isEmpty && activeContainerType != ContainerType.None)

{

Console.ForegroundColor = ConsoleColor.Yellow;

Console.WriteLine("The active container is empty.");

Console.ResetColor();

}

else if (activeContainerType == ContainerType.None)

{

PrintErrorMessage("No container selected. Please use option 1 or 2 first.");

isEmpty = true;

}

return isEmpty;

}

static int GetActiveContainerCount()

{

if (activeContainerType == ContainerType.Array && containerArray != null)

{

return containerArray.GetCount();

}

else if (activeContainerType == ContainerType.LinkedList && containerList != null)

{

return containerList.Count;

}

return 0;

}

// Gets the next insertion ID (0-based)

static int GetNextInsertionId()

{

if (activeContainerType == ContainerType.Array && containerArray != null)

{

return containerArray.GetInsertionId();

}

else if (activeContainerType == ContainerType.LinkedList && containerList != null)

{

return containerList.GetNextInsertionId();

}

return 0;

}

// Finds the current 0-based index of an item

private static int FindIndexByReference(IName itemToFind)

{

if (itemToFind == null) return -1;

if (activeContainerType == ContainerType.Array && containerArray != null)

{

IName?[] currentItems = containerArray.GetItems();

int currentCount = containerArray.GetCount();

for (int i = 0; i < currentCount; i++)

{

if (object.ReferenceEquals(currentItems[i], itemToFind))

{

return i;

}

}

}

else if (activeContainerType == ContainerType.LinkedList && containerList != null)

{

var node = containerList.First;

int index = 0;

while (node != null)

{

if (object.ReferenceEquals(node.Data, itemToFind))

{

return index;

}

node = node.Next;

index++;

}

}

return -1;

}

private static int GetInsertionIdForItem(IName itemToFind)

{

if (itemToFind == null) return -1;

int index = FindIndexByReference(itemToFind);

if (index == -1) return -1;

try

{

if (activeContainerType == ContainerType.Array && containerArray != null)

{

int[] order = containerArray.GetInsertionOrder();

if (index < order.Length)

{

return order[index];

}

else { System.Diagnostics.Debug.WriteLine($"Warning: Index {index} out of bounds for insertion Order Array (Length: {order.Length})"); }

}

else if (activeContainerType == ContainerType.LinkedList && containerList != null)

{

List<int> order = containerList.GetInsertionOrder();

if (index < order.Count)

{

return order[index];

}

else { System.Diagnostics.Debug.WriteLine($"Warning: Index {index} out of bounds for insertion Order List (Count: {order.Count})"); }

}

}

catch (Exception ex)

{

System.Diagnostics.Debug.WriteLine($"Error in GetInsertionIdForItem for index {index}: {ex.Message}");

}

return -1;

}

// Gets an item by Insertion ID from the active container

private static IName? GetItemByInsertionId(int insertionId)

{

try

{

if (activeContainerType == ContainerType.Array && containerArray != null)

{

return containerArray[insertionId];

}

else if (activeContainerType == ContainerType.LinkedList && containerList != null)

{

return containerList[insertionId];

}

}

catch (IndexOutOfRangeException) { /\* ID not found or invalid for container \*/ }

catch (Exception ex) { PrintErrorMessage($"Unexpected error fetching item by insertion ID {insertionId + 1}: {ex.Message}"); }

return null;

}

private static IName? GetItemByCurrentIndex(int index)

{

if (index < 0) return null;

if (activeContainerType == ContainerType.Array && containerArray != null)

{

IName?[] items = containerArray.GetItems();

int count = containerArray.GetCount();

if (index < count)

{

return items[index];

}

}

else if (activeContainerType == ContainerType.LinkedList && containerList != null)

{

if (index < containerList.Count)

{

var node = containerList.First;

int i = 0;

while (node != null && i < index)

{

node = node.Next;

i++;

}

return node?.Data;

}

}

return null;

}

// --- Random Generators ---

static Product GenerateRandomProduct(Random random)

{

string[] names = { "Table", "Chair", "Lamp", "Phone", "Book", "Laptop", "Mug" };

decimal price = random.Next(10, 1000) + (decimal)random.NextDouble();

return new Product(names[random.Next(names.Length)] + random.Next(100), Math.Max(0.01m, Math.Round(price, 2)));

}

static RealEstate GenerateRandomRealEstate(Random random)

{

string[] names = { "Cozy Apt", "Luxury Villa", "Small House", "Big Mansion", "Downtown Loft" };

string[] locations = { "New York", "London", "Paris", "Tokyo", "Kyiv", "Berlin", "Sydney" };

string[] types = { "Residential", "Commercial", "Industrial", "Mixed-Use" };

decimal price = random.Next(100000, 1000000) + (decimal)random.NextDouble() \* 1000;

double size = random.Next(50, 500) + random.NextDouble() \* 10;

return new RealEstate(names[random.Next(names.Length)], Math.Max(0.01m, Math.Round(price, 2)), locations[random.Next(locations.Length)], Math.Max(1.0, Math.Round(size, 1)), types[random.Next(types.Length)]);

}

static RealEstateInvestment GenerateRandomRealEstateInvestment(Random random)

{

string[] names = { "Office Bldg", "Shopping Mall", "Warehouse", "Apt Complex", "Data Center" };

string[] locations = { "Chicago", "Los Angeles", "Houston", "Phoenix", "Philadelphia", "Dallas" };

string[] invTypes = { "REIT", "Direct Prop", "Mortgage Fund", "Syndication" };

decimal price = random.Next(500000, 5000000) + (decimal)random.NextDouble() \* 10000;

decimal marketValue = price \* (decimal)(0.8 + random.NextDouble() \* 0.4);

return new RealEstateInvestment(names[random.Next(names.Length)], Math.Max(0.01m, Math.Round(price, 2)), locations[random.Next(locations.Length)], Math.Max(1.0m, Math.Round(marketValue, 2)), invTypes[random.Next(invTypes.Length)]);

}

static Apartment GenerateRandomApartment(Random random)

{

string[] names = { "Studio Apt", "1BR Apt", "2BR Apt", "Penthouse", "Garden Apt" };

string[] locations = { "Miami", "San Francisco", "Seattle", "Boston", "Denver", "Austin" };

string[] types = { "Condo", "Co-op", "Rental Unit", "Loft" };

decimal price = random.Next(200000, 800000) + (decimal)random.NextDouble() \* 500;

double size = random.Next(40, 150) + random.NextDouble() \* 5;

int floor = random.Next(1, 30);

decimal hoa = random.Next(50, 500) + (decimal)random.NextDouble() \* 50;

return new Apartment(names[random.Next(names.Length)], Math.Max(0.01m, Math.Round(price, 2)), locations[random.Next(locations.Length)], Math.Max(1.0, Math.Round(size, 1)), types[random.Next(types.Length)], floor, Math.Max(0m, Math.Round(hoa, 2)));

}

static House GenerateRandomHouse(Random random)

{

string[] names = { "Bungalow", "Townhouse", "Ranch", "Cottage", "Colonial" };

string[] locations = { "Atlanta", "Dallas", "San Diego", "Orlando", "Las Vegas", "Nashville" };

string[] types = { "Single-family", "Multi-family", "Duplex" };

decimal price = random.Next(300000, 1200000) + (decimal)random.NextDouble() \* 1000;

double size = random.Next(100, 400) + random.NextDouble() \* 15;

double gardenSize = random.Next(-50, 1000) + random.NextDouble() \* 100;

bool pool = random.Next(3) == 0;

return new House(names[random.Next(names.Length)], Math.Max(0.01m, Math.Round(price, 2)), locations[random.Next(locations.Length)], Math.Max(1.0, Math.Round(size, 1)), types[random.Next(types.Length)], Math.Max(0.0, Math.Round(gardenSize, 1)), pool);

}

static Hotel GenerateRandomHotel(Random random)

{

string[] names = { "Luxury Hotel", "Budget Inn", "Resort & Spa", "Boutique Hotel", "Airport Motel" };

string[] locations = { "Hawaii", "Bali", "Maldives", "Fiji", "Santorini", "Las Vegas Strip" };

string[] invTypes = { "Hospitality REIT", "Hotel Mgmt", "Timeshare", "Franchise" };

decimal price = random.Next(1000000, 10000000) + (decimal)random.NextDouble() \* 50000;

decimal marketValue = price \* (decimal)(0.9 + random.NextDouble() \* 0.3);

int rooms = random.Next(20, 500);

int rating = random.Next(1, 6);

return new Hotel(names[random.Next(names.Length)], Math.Max(0.01m, Math.Round(price, 2)), locations[random.Next(locations.Length)], Math.Max(1.0m, Math.Round(marketValue, 2)), invTypes[random.Next(invTypes.Length)], Math.Max(1, rooms), rating);

}

static LandPlot GenerateRandomLandPlot(Random random)

{

string[] names = { "Farmland", "Forest", "Comm Land", "Resid Land", "Waterfront" };

string[] locations = { "Rural Area", "Suburban Edge", "Urban Infill", "Coastal Zone", "Mountain Base" };

string[] invTypes = { "Land Banking", "Development", "Agriculture", "Conservation" };

string[] soilTypes = { "Loam", "Clay", "Sand", "Silt", "Peat", "Chalky" };

decimal price = random.Next(50000, 500000) + (decimal)random.NextDouble() \* 2000;

decimal marketValue = price \* (decimal)(0.7 + random.NextDouble() \* 0.6);

bool infra = random.Next(2) == 0;

return new LandPlot(names[random.Next(names.Length)], Math.Max(0.01m, Math.Round(price, 2)), locations[random.Next(locations.Length)], Math.Max(1.0m, Math.Round(marketValue, 2)), invTypes[random.Next(invTypes.Length)], soilTypes[random.Next(soilTypes.Length)], infra);

}

// --- Manual Creation Methods ---

static Product CreateManualProduct()

{

string name = ReadString("Enter Product Name: ");

decimal price = ReadDecimal("Enter Product Price (> 0): ", minValue: 0.01m);

return new Product(name, price);

}

static RealEstate CreateManualRealEstate()

{

string name = ReadString("Enter RealEstate Name: ");

decimal price = ReadDecimal("Enter RealEstate Price (> 0): ", minValue: 0.01m);

string location = ReadString("Enter Location: ");

double size = ReadDouble("Enter Size (> 0): ", minValue: 0.01);

string type = ReadString("Enter Type (e.g., Residential): ");

return new RealEstate(name, price, location, size, type);

}

static RealEstateInvestment CreateManualRealEstateInvestment()

{

string name = ReadString("Enter Investment Name: ");

decimal price = ReadDecimal("Enter Investment Price (> 0): ", minValue: 0.01m);

string location = ReadString("Enter Location: ");

decimal marketValue = ReadDecimal("Enter Market Value (> 0): ", minValue: 0.01m);

string investmentType = ReadString("Enter Investment Type (e.g., REIT): ");

return new RealEstateInvestment(name, price, location, marketValue, investmentType);

}

static Apartment CreateManualApartment()

{

string name = ReadString("Enter Apartment Name: ");

decimal price = ReadDecimal("Enter Apartment Price (> 0): ", minValue: 0.01m);

string location = ReadString("Enter Location: ");

double size = ReadDouble("Enter Size (> 0): ", minValue: 0.01);

string type = ReadString("Enter Type (e.g., Condo): ");

int floorNumber = ReadInt("Enter Floor Number (> 0): ", minValue: 1);

decimal hoaFees = ReadDecimal("Enter HOA Fees (>= 0): ", minValue: 0m);

return new Apartment(name, price, location, size, type, floorNumber, hoaFees);

}

static House CreateManualHouse()

{

string name = ReadString("Enter House Name: ");

decimal price = ReadDecimal("Enter House Price (> 0): ", minValue: 0.01m);

string location = ReadString("Enter Location: ");

double size = ReadDouble("Enter Size (> 0): ", minValue: 0.01);

string type = ReadString("Enter Type (e.g., Single-family): ");

double gardenSize = ReadDouble("Enter Garden Size (>= 0): ", minValue: 0.0);

bool pool = ReadBool("Has Pool (true/false/yes/no/1/0): ");

return new House(name, price, location, size, type, gardenSize, pool);

}

static Hotel CreateManualHotel()

{

string name = ReadString("Enter Hotel Name: ");

decimal price = ReadDecimal("Enter Hotel Price (> 0): ", minValue: 0.01m);

string location = ReadString("Enter Location: ");

decimal marketValue = ReadDecimal("Enter Market Value (> 0): ", minValue: 0.01m);

string investmentType = ReadString("Enter Investment Type: ");

int rooms = ReadInt("Enter Number of Rooms (> 0): ", minValue: 1);

int starRating = ReadInt("Enter Star Rating (1-5): ", minValue: 1, maxValue: 5);

return new Hotel(name, price, location, marketValue, investmentType, rooms, starRating);

}

static LandPlot CreateManualLandPlot()

{

string name = ReadString("Enter LandPlot Name: ");

decimal price = ReadDecimal("Enter LandPlot Price (> 0): ", minValue: 0.01m);

string location = ReadString("Enter Location: ");

decimal marketValue = ReadDecimal("Enter Market Value (> 0): ", minValue: 0.01m);

string investmentType = ReadString("Enter Investment Type: ");

string soilType = ReadString("Enter Soil Type (e.g., Loam): ");

bool infrastructureAccess = ReadBool("Has Infrastructure Access (true/false/yes/no/1/0): ");

return new LandPlot(name, price, location, marketValue, investmentType, soilType, infrastructureAccess);

}

// --- Robust Input Reading Helpers ---

static string ReadString(string prompt)

{

Console.ForegroundColor = ConsoleColor.Yellow;

Console.Write(prompt);

Console.ResetColor();

return Console.ReadLine() ?? "";

}

static decimal ReadDecimal(string prompt, decimal? minValue = null, decimal? maxValue = null)

{

decimal value;

while (true)

{

Console.ForegroundColor = ConsoleColor.Yellow;

Console.Write(prompt);

Console.ResetColor();

string? input = Console.ReadLine();

if (decimal.TryParse(input, NumberStyles.Any, CultureInfo.InvariantCulture, out value))

{

if ((minValue == null || value >= minValue) && (maxValue == null || value <= maxValue))

{

return value;

}

else

{

string minStr = minValue?.ToString("N2", CultureInfo.InvariantCulture) ?? "-infinity";

string maxStr = maxValue?.ToString("N2", CultureInfo.InvariantCulture) ?? "+infinity";

PrintErrorMessage($"Value must be{(minValue != null ? $" >= {minStr}" : "")}{(minValue != null && maxValue != null ? " and" : "")}{(maxValue != null ? $" <= {maxStr}" : "")}.");

}

}

else

{

PrintErrorMessage($"Invalid decimal format. Please use '.' as the decimal separator (e.g., 123.45). Input was: '{input}'");

}

}

}

static double ReadDouble(string prompt, double? minValue = null, double? maxValue = null)

{

double value;

while (true)

{

Console.ForegroundColor = ConsoleColor.Yellow;

Console.Write(prompt);

Console.ResetColor();

string? input = Console.ReadLine();

if (double.TryParse(input, NumberStyles.Any, CultureInfo.InvariantCulture, out value))

{

if ((minValue == null || value >= minValue) && (maxValue == null || value <= maxValue))

{

return value;

}

else

{

string minStr = minValue?.ToString("N1", CultureInfo.InvariantCulture) ?? "-infinity";

string maxStr = maxValue?.ToString("N1", CultureInfo.InvariantCulture) ?? "+infinity";

PrintErrorMessage($"Value must be{(minValue != null ? $" >= {minStr}" : "")}{(minValue != null && maxValue != null ? " and" : "")}{(maxValue != null ? $" <= {maxStr}" : "")}.");

}

}

else

{

PrintErrorMessage($"Invalid number format. Please use '.' as the decimal separator (e.g., 12.3). Input was: '{input}'");

}

}

}

static int ReadInt(string prompt, int? minValue = null, int? maxValue = null)

{

int value;

while (true)

{

Console.ForegroundColor = ConsoleColor.Yellow;

Console.Write(prompt);

Console.ResetColor();

string? input = Console.ReadLine();

if (int.TryParse(input, NumberStyles.Integer, CultureInfo.InvariantCulture, out value))

{

if ((minValue == null || value >= minValue) && (maxValue == null || value <= maxValue))

{

return value;

}

else

{

string minStr = minValue?.ToString(CultureInfo.InvariantCulture) ?? "any";

string maxStr = maxValue?.ToString(CultureInfo.InvariantCulture) ?? "any";

PrintErrorMessage($"Value must be between {minStr} and {maxStr}.");

}

}

else

{

PrintErrorMessage($"Invalid integer format. Input was: '{input}'");

}

}

}

static bool ReadBool(string prompt)

{

while (true)

{

Console.ForegroundColor = ConsoleColor.Yellow;

Console.Write(prompt);

Console.ResetColor();

string input = Console.ReadLine()?.Trim().ToLowerInvariant() ?? "";

if (input == "true" || input == "1" || input == "yes" || input == "y") return true;

if (input == "false" || input == "0" || input == "no" || input == "n") return false;

PrintErrorMessage("Invalid boolean input. Use true/false/yes/no/1/0.");

}

}

}