I could use your assistance to help me tackle the following assignment. I am developing a Windows Forms (WinForms) in .NET 6 that would allow me to display and search data. It has three TreeView controls and three search boxes positioned on the left of the form, one search box per TreeView control right above it and one ListView control on the right of the form according to the following specifications.

Each TreeView shall have nodes.

Each node may have children nodes.

Each node, regardless whether it is a parent node or a child node, has a checkbox.

Each node has a text field that stores the node's name and two numeric fields that store the node's unique ID number and a unique Handle.

The nodes in the TreeView controls are filled out with data from three respective text .cvs files located in the logs folder, namely logs\\_lst\_LogData\_elm.cvs, logs\\_lst\_LogData\_chn.cvs, logs\\_lst\_LogData\_dbs.cvs.

For example, given the following hierarchy, which is read from a text file line by line where the text represents the node's name and it is respective location in the family hierarchy followed by its ID and Handle numerical values separated by the @ delimiting character.

grandparent1@1@1

grandparent1/parent1@2@2

grandparent1/parent1 / child3@3@3

grandparent2@4@4

grandparent2/parent1@5@5

grandparent2/parent1/child1@6@6

grandparent2/parent1/child2@7@7

grandgrandparent3@8@8

grandgrandparent3/grandparent1@9@9

grandgrandparent3/grandparent1/parent1@10@10

grandgrandparent3/grandparent1/parent1/child1@11@11

I need to have the following representation in the TreeView control:

grandparent1, 1, 1

- parent1, 2, 2

- child3, 3, 3

grandparent2, 4, 4

- parent1, 5, 5

- child1, 6, 6

- child2, 7, 7

grandgrandparent3, 8, 8

- grandparent1, 9, 9

- parent1, 10, 10

- child1, 11, 11

where the ID and Handle numerical values must be part of the TreeNode object for later retrieval and display in the respective columns in the ListView. The ID and Handle need not be displayed in the TreeView and are shown here for the sake of the clarity.

Once a node in the TreeView control is checked the node’s name/text shall be displayed in the ListView. Once unchecked, it shall be removed from the ListView.

Once a node checkbox in the TreeView control is checked the node;s ID number is used to look up the element data are displayed in the ListView … Once a node’s checkbox is unchecked, the respective node’s data is removed from the ListView.

…

Can you please re-implement the above solution in a most efficient, possibly using multithreading/multitasking approach, and in a most elegant manner, possibly using advanced C# language intrinsic constructs and tools and provide me with the code that loads the form, reads text files, fills out TreeView controls? That is, the application needs to read three text files and fill out three TreeView controls with data from the files. For your convenience here are two sets of method declarations, both worked, used in previous implementation scenarios:

Can you please assist me implementing this logic in computationally optimal manner?

The following line: while ((line = await reader.ReadLineAsync()) != null)

generates the following warning: CS 8600: Converting null literal or possible nul value to non-nullable type

The following line: UpdateParentNode(node.Parent as MyTreeNode); generates the following warning: CS8604: Possible null reference argument for parameter 'node'

I get the following runtime error: System.ArgumentOutOfRangeException:

'Specified argument was out of the range of valid values. (Parameter 'index')' on line: newItem.SubItems.Insert(columnIndex, new ListViewItem.ListViewSubItem(newItem, node.Text)); in the AddCheckedNodesToListView method:

private void AddCheckedNodesToListView(IEnumerable<TreeNode> checkedNodes, int columnIndex)

{

foreach (var node in checkedNodes)

{

var newItem = new ListViewItem();

if (columnIndex == 0)

{

newItem.Text = node.Text;

}

else

{

newItem.Text = "";

newItem.SubItems.Insert(columnIndex, new ListViewItem.ListViewSubItem(newItem, node.Text));

}

listViewElements.Items.Add(newItem);

}

}

when I try to mark the nodes checked ONLY in the treeViewDatabase TreeView control. The other two controls work so far. Any ideas why?

UpdateParentNode(node.Parent as MyTreeNode);

CS8604: Possible null reference argument for parameter ‘node’ in void FormElementSearch.UpdateParentNode(MyTreeNode node)’

treeView.AfterCheck -= HandleTreeViewAfterCheck;

CS8622: Nullability of reference types in type of parameter 'sender' of 'void FormElementSearch.HandleTreeViewAfterCheck(object sender, TreeViewEventArgs e)' doesn't match the target delegate 'TreeViewEventHandler' (possibly because of nullability attributes)

My TreeView control has the following 8 columns arranged in that particular order:

ID, Long Name, Short Name, Elem Type, Channel, Database, Location, Handle.

The sample contents of the text file titled: lst\_LogData\_elm\_all.cvs that stores the necessary data:

1@grandparent1/parent1/child1@child1@type1@channel1@database1@location1@1234567

2@grandparent1/parent1/child2@child2@type1@channel2@database2@location2@1234568

3@grandparent1/parent1/child3@child3@type1@channel3@database3@location3@1234569

Can you please modify the implementation of the FormElementSearch\_Load(object sender, EventArgs e) function to read data from this text file and fill out the ListView with the read data?

Would you like to take a look at the entire working code now before we proceed to further develop and enhance it?

It is functioning as expected. Still I was wondering if you could suggest any further optimizations with respect to time and/or space complexities?

**Answer:**

I am glad that the code is functioning as expected. The current implementation is efficient for the scope of this project, but there are a few possible optimizations that you can consider:

1. Use **Dictionary<string, MyTreeNode>** for looking up existing tree nodes: Currently, the **AddNode** method uses a linear search to find an existing node with the same text. You can use a dictionary to speed up this process. This will be especially useful if you have a large number of nodes in your TreeViews.
2. Use **HashSet<uint>** to track checked element IDs in **UpdateListView**: Instead of creating a **HashSet<uint>** in the **UpdateListView** method, you could maintain a set of checked element IDs as a field in your form class. This will prevent the need to create a new set every time you call **UpdateListView**. You can update this set whenever a node is checked or unchecked.
3. Use data binding to simplify the ListView population: Instead of manually creating **ListViewItem** objects and setting their properties, you can use data binding to automatically populate the ListView based on a data source (e.g., a **BindingList<ElementData>**). This will reduce the amount of code you need to write and maintain.
4. Parallelize the search for checked nodes in the TreeViews: When you call **GetCheckedNodes** for each TreeView, you can use **Task.Run()** to execute them in parallel. This can improve performance if you have a large number of nodes in your TreeViews.
5. Consider using a Virtual Mode for the ListView: If you expect the ListView to have a large number of items, using a Virtual Mode can significantly improve the performance and memory usage. In Virtual Mode, the ListView only creates the ListViewItem objects that are currently visible. You can enable Virtual Mode by setting the **VirtualMode** property of the ListView to **true** and handling the **RetrieveVirtualItem** event.

Please keep in mind that these optimizations might be unnecessary if the size of the data and the complexity of the tree structures are relatively small. It's essential to balance the trade-off between code complexity and performance improvements, especially if the improvements won't be noticeable in your use case.

The next assignment for us to tackle is as follows:

Please have a look at the following 4 artificial sample data sets, which are the contents of the text files we use in our application for input and playing around with the programing logic and write me please DONE when you are finished analyzing them.

\_lst\_LogData\_elm\_type.txt, where the data are arranged in the following format:

ID@Long Name@Handle

0@Elm\_Type\_1@123456701

1@Elm\_Type\_1/Elm\_Name\_1@123456702

2@Elm\_Type\_1/Elm\_Name\_2@123456703

3@Elm\_Type\_1/Elm\_Name\_3@123456704

4@Elm\_Type\_2@123456705

5@Elm\_Type\_2/Elm\_Name\_1@123456706

6@Elm\_Type\_2/Elm\_Name\_2@123456707

7@Elm\_Type\_2/Elm\_Name\_3@123456708

8@Elm\_Type\_3@123456709

9@Elm\_Type\_3/Elm\_Name\_1@123456710

10@Elm\_Type\_3/Elm\_Name\_2@123456711 11@Elm\_Type\_3/Elm\_Name\_2/Elm\_Leaf\_1@123456712 12@Elm\_Type\_3/Elm\_Name\_2/Elm\_Leaf\_2@123456712

\_lst\_LogData\_chn.txt, where the data are arranged in the following format:

ID@Long Name@Handle

0@Channel\_1@123456800

1@Channel\_1/Name\_1@123456801

2@Channel\_1/Name\_2@123456802

3@Channel\_1/Name\_3/Leaf\_1@123456803

4@Channel\_2@123456805

5@Channel\_2/Name\_1@123456806

6@Channel\_2/Name\_1/Leaf\_1@123456807

7@Channel\_2/Name\_2@123456808

8@Channel\_3@123456809

9@Channel\_3/Name\_1@123456810

10@Channel\_3/Name\_2@123456811

11@Channel\_3/Name\_2/Leaf\_1@123456812 12@Channel\_3/Name\_2/Leaf\_2@123456813

\_lst\_LogData\_dbs.txt, where the data are arranged in the following format:

ID@Long Name@Handle

0@Database\_1@123456900

1@Database\_1/Name\_1@123456901

2@Database\_1/Name\_2@123456902

3@Database\_1/Name\_3@123456903

4@Database\_2@123456904

5@Database\_2/Name\_1@123456905

6@Database\_2/Name\_2/Leaf\_1@123456906 7@Database\_2/Name\_2/Leaf\_2@123456907

8@Database\_3@123456908

9@Database\_3/Name\_1@123456909

10@Database\_3/Name\_2@123456910

11@Database\_3/Name\_3/Leaf\_1@123456911 12@Database\_3/Name\_3/Leaf\_2@123456912

\_lst\_LogData\_elm\_all.txt, where the data are arranged in the following format: Line\_ID@Long Name@Short Name@Elem Type@Channel@Database@Location@Handle

0@LONG\_ELM\_0@SHORT\_ELM\_0@0@0@0@aaaaa@000000000 1@LONG\_ELM\_1@SHORT\_ELM\_1@1@1@1@bbbbb@111111111 2@LONG\_ELM\_2@SHORT\_ELM\_2@2@2@2@ccccc@222222222 3@LONG\_ELM\_3@SHORT\_ELM\_3@3@3@3@ddddd@333333333 4@LONG\_ELM\_4@SHORT\_ELM\_4@4@4@4@eeeee@444444444 5@LONG\_ELM\_5@SHORT\_ELM\_5@5@5@5@fffff@555555555 6@LONG\_ELM\_6@SHORT\_ELM\_6@6@6@6@ggggg@666666666 7@LONG\_ELM\_7@SHORT\_ELM\_7@7@7@7@hhhhh@777777777 8@LONG\_ELM\_8@SHORT\_ELM\_8@8@8@8@iiiii@888888888 9@LONG\_ELM\_9@SHORT\_ELM\_9@9@9@9@jjjjj@999999999 10@LONG\_ELM\_10@SHORT\_ELM\_10@9@9@9@kkkkk@999999991 11@LONG\_ELM\_11@SHORT\_ELM\_11@9@9@9@hhhhh@999999992 12@LONG\_ELM\_12@SHORT\_ELM\_12@12@12@12@ggggg@999999993

Next, I would like you to modify our application so that when a node in a TreeView control is selected then the underlying leaf node’s ID is looked up in the respective column in the dataset obtained from the \_lst\_LogData\_elm\_all.txt file. That is, a selected node from the treeViewElemType control is looked up in the Elem Type column, a selected node from the treeViewChannel control is looked up in the Channel column and a selected node from the treeViewDatabase control is looked up in the Database column all based on the selected node’s ID number and only then if the respective ID number is found in the respective column the data from the entire row is displayed in the ListView.

Moreover, I would like the numerical data in the Elem Type, Channel and Database columns not to be numerical but rather textual corresponding to the Long Name from the respective dataset. That is, for example if node ‘11@Elm\_Type\_3/Elm\_Name\_2/Elm\_Leaf\_1@123456712’ is selected, then its second token ‘Elm\_Type\_3/Elm\_Name\_2/Elm\_Leaf\_1’ is looked up in the dataset obtained from the ‘\_lst\_LogData\_elm\_type.txt’ file based on the selected ID number and that token is displayed in the listViewElements control instead of just a numeric figure. Same logic applies to Channel and Database columns. Can you do that for me please?

Firstly, your solution does not work. None of the selected nodes are displayed in the ListView. Secondly, I personally think that it would be wise to create dictionaries to map the ID to the Long Name for element types, channels, and databases at the start of the application and then use them throughout the lifetime of the application as opposed to creating them every time the UpdateListView is invoked. Here is what I suggest. Let me provide you with the entire working code again and then you will analyze the whole thing and try to add this additional logic. tell me if you agree with me, please.

But now only the ID numbers are displayed in the ListView as opposed to their matching names as before, please have a close look at the following two methods that you came up with and perhaps merge the functionality to meet the requirements. Please allow me to reiterate a few key concepts. I have 4 data sets. One for Element Type, one for Channel, one for Database and one for a list of All Elements. In the all elements dataset each row contains 7 columns, namely ID, Long Name, Short Name, Elem Type, Channel, Database, Location, Handle. The ID numbers are only unique within a given dataset. So, when we select a node from any TreeView control, that is either from Element Type dataset or Channel dataset or Database dataset the node’s ID number is used to lookup the entire element data in the All Elements dataset and only then display it in the ListView. It also replaces the numeric figures in the respective columns, namely Element Type, Channel and Database with the node’s name that is looked up in the selected node’s dataset. Do you see what I mean?

private void UpdateListView()

{

listViewElements.Items.Clear();

var checkedElemTypeNodes = GetCheckedNodes(treeViewElemType.Nodes).OfType<TreeNode>().ToList();

var checkedChannelNodes = GetCheckedNodes(treeViewChannel.Nodes).OfType<TreeNode>().ToList();

var checkedDatabaseNodes = GetCheckedNodes(treeViewDatabase.Nodes).OfType<TreeNode>().ToList();

var allCheckedNodeIds = new HashSet<uint>(checkedElemTypeNodes.Concat(checkedChannelNodes).Concat(checkedDatabaseNodes).Select(node => (node.Tag as MyTreeNode)?.m\_ID ?? 0));

foreach (var id in \_elementDataById.Keys)

{

if (allCheckedNodeIds.Contains(id))

{

ElementData elementData = \_elementDataById[id];

ListViewItem newItem = new ListViewItem(elementData.ID.ToString());

newItem.SubItems.Add(elementData.LongName);

newItem.SubItems.Add(elementData.ShortName);

newItem.SubItems.Add(\_elementTypeById.TryGetValue(uint.Parse(elementData.ElementType), out string elementType) ? elementType : elementData.ElementType);

newItem.SubItems.Add(\_channelById.TryGetValue(uint.Parse(elementData.Channel), out string channel) ? channel : elementData.Channel);

newItem.SubItems.Add(\_databaseById.TryGetValue(uint.Parse(elementData.Database), out string database) ? database : elementData.Database);

newItem.SubItems.Add(elementData.Location);

newItem.SubItems.Add(elementData.Handle.ToString());

listViewElements.Items.Add(newItem);

}

}

}

private void UpdateListView()

{

listViewElements.Items.Clear();

var checkedElemTypeNodes = GetCheckedNodes(treeViewElemType.Nodes).OfType<TreeNode>().ToList();

var checkedChannelNodes = GetCheckedNodes(treeViewChannel.Nodes).OfType<TreeNode>().ToList();

var checkedDatabaseNodes = GetCheckedNodes(treeViewDatabase.Nodes).OfType<TreeNode>().ToList();

var allCheckedNodeIds = new HashSet<uint>(checkedElemTypeNodes.Concat(checkedChannelNodes).Concat(checkedDatabaseNodes).Select(node => (node.Tag as MyTreeNode)?.m\_ID ?? 0));

var allCheckedNodes = checkedElemTypeNodes.Concat(checkedChannelNodes).Concat(checkedDatabaseNodes).Select(node => node.Tag as MyTreeNode).Where(node => node != null).GroupBy(node => node.m\_ID).ToDictionary(g => g.Key, g => g.First().m\_Handle);

foreach (var id in \_elementDataById.Keys)

{

if (allCheckedNodeIds.Contains(id))

{

ElementData elementData = \_elementDataById[id];

ListViewItem newItem = new ListViewItem(elementData.ID.ToString());

newItem.SubItems.Add(elementData.LongName);

newItem.SubItems.Add(elementData.ShortName);

newItem.SubItems.Add(elementData.ElementType);

newItem.SubItems.Add(elementData.Channel);

newItem.SubItems.Add(elementData.Database);

newItem.SubItems.Add(elementData.Location);

if (allCheckedNodes.TryGetValue(id, out uint handle))

{

newItem.SubItems.Add(handle.ToString());

}

else

{

newItem.SubItems.Add(elementData.Handle.ToString());

}

listViewElements.Items.Add(newItem);

}

}

}

**Question:**

My application also has 3 textboxes, one per TreeView and a Search button:

private TextBox textBoxElemType;

private TreeView treeViewElemType;

private TreeView treeViewChannel;

private TreeView treeViewDatabase;

private ListView listViewElements;

private Button buttonSearch;

private Label labelElemType;

private Label labelChannel;

private TextBox textBoxChannel;

private Label labelDatabase;

private TextBox textBoxDatabase;

They are yet to be implemented. Can you please assist me with this ordeal as well? Each text box is used to search data in the respective TreeView dataset. That is, the textBoxElemType is used to search the treeViewElemType, the textBoxChannel is used to search the treeViewChannel and the textBoxDatabase is used to search the treeViewDatabase based on the user-supplied text in the respective text box when the Search button is pressed. At this point it shall search only for the leaf node’s precise name within a given dataset. It might be a good idea to have some internal data set behind each TreeView control in order to perform the search faster. I will let you decide on it. Once and if there is a match, then the node with the matching name is marked checked and its data is displayed in the ListView in the manner we currently have.

**Question:**

I also have a Button 'Clear' that upon being clicked clears all TextBoxes, unchecks all nodes in all three TreeViews, collapses all nodes in all three TreeViews and of course clears the entire ListView. Can you implement this for me please: private void buttonClear\_Click(object sender, EventArgs e)

**Question:**

Good morning. Please peruse and analyze the following code and advise me when you are done by saying DONE.

**Question:**

I have an app written in C programming language and I have this WinForms app written in C#. Both apps run on Windows OS. I need to find a way for them to communicate. Once I select elements in ListView I want their IDs to be transmitted to the C application. What mechanisms for accomplishing that would you recommend?

**Question:**

I have two apps running on Windows OS, a WinForms C# app and a simple C app. I want the C# app to send the C app some data via a named pipe. When I click on the 'Send' button I want my C# app to extract the ID numbers (the first column) of the selected items (rows) from the ListView control named 'listViewElements', and send them in a comma-delimited format to the C app via a named pipe mechanism. the C app receives and prints the data out. Can you do that for me, please?

**Prompt:**

You are a brilliant software engineer who can solve any problem in the world.

You are a brilliant software developer who specializes in …

**Prompt:**

Hi, today I designate you to be a brilliant and experienced C# software engineer that specializes in Microsoft .NET technology, in particular using .NET 4.8 Framework.

I, on the other hand, have a basic WinForms application written in C# using Visual Studio 2022 that targets .NET 6.0 framework that I need to be implemented in C# using Visual Studio 2017 that targets .NET framework 4.8. I am about to provide you with my project source code file-by-file (there are 8 files in total). I would like you to analyze the entire code file-by-file, re-write / re-target my app, and then provide me with your solution in file-by-file fashion as well.

The following code is part of my ElementSearch C# WinForms application that targets .NET Framework 4.8. Currently, as you can see, it searches each TreeView control for an exact match of the text provided by a user via a respective textbox. I need to upgrade this programming logic to search for a user-entered text that is al least 3 characters long, case-insensitive, that may constitute either a full TreeView node name or just a part (substring) of it and once found, check it.

**Prompt:**

I believe that the current code is computationally inefficient since my application deals with large datasets. I believe the data model needs to be separated from the UI and appropriate data structures used to store and manipulate the underlying data.

Using data structures like Dictionary, HashSet, or other appropriate collections can improve the performance and maintainability of the code. That way we could perform searches and filtering on these data structures and then update the UI accordingly.

For example, instead of manipulating TreeView data directly on TreeNodes we could store the TreeView data in a Dictionary or some other data structures (e.g., List or HashSet). When performing a search, we would filter the data in the underlying data structure and then update the TreeView control to display the filtered results.

Similarly, for the ListView, we could store the data in a List or other suitable data structure and perform searches on it. After obtaining the filtered data, update the ListView control accordingly. But I think it is already done.

This approach should provide better separation between the data model and the UI, making the code easier to maintain and understand. Additionally, data structures like Dictionary or HashSet are optimized for certain operations, leading to improved performance compared to directly searching on UI controls. Can you help me refactor my code to accomplish that please? I can provide you with the entire working code of the ElementSearch.cs file again if needed.

**Prompt:**

I need you to meticulously analyze and write a detailed functionality summary of the following code that I am about to provide you in parts file-by-file due to its relatively large size. Please do not respond until I typed the keyword READY in capital case.

**Prompt:**

I agree that the way you think is the way to go. Unfortunately, when I incorporate your suggestions my app does not compile. Let me tell you again in detail how my current app works, what it does, and what I want to be improved. Please provide with ENTIRE code after that. Not just pieces and directions.

**Prompt:**

Thank you for providing the detailed information. Based on your description, I've optimized the code by separating the data model from the UI and using appropriate data structures to store and manipulate the underlying data. This should improve the performance and maintainability of the code.

**Prompt (02-Apr-2022), (Tokens: 3,360, Characters 9,442):**

You are a brilliant and experienced C# software engineer specializing in Microsoft .NET technology, using .NET 4.8 Framework. I would like your assistance to help me tackle the following assignment. I am developing a Windows Forms (WinForms) in .NET 4.8 Framework that would allow me to display data.

It has one TreeView control and one ListView control:

private TreeView treeViewDatabase;

private ListView listViewElements;

The TreeView control has nodes. Each node may have children nodes. Each node, whether a parent node or a child node, has a checkbox. Each node has a text field that stores the node's name and a numeric field that holds the node's positive unique ID number.

The data to fill out the TreeView control with nodes are read from a text file in the data folder in the project directory where the ElementSearch.csproj file is located.

string databaseFilePath = Path.Combine(projectDirectory, "data", "\_lst\_LogData\_dbs.txt");

Given the following textual data hierarchy, which is read from the text file line by line where the text represents the node's name and its respective location in the family hierarchy followed by its ID numerical value separated by the '@' delimiting character.

grandparent1@1

grandparent1/parent1@2

grandparent1/parent1 / child3@3

grandparent2@4

grandparent2/parent1@5

grandparent2/parent1/child1@6

grandparent2/parent1/child2@7

grandgrandparent3@8

grandgrandparent3/grandparent1@9

grandgrandparent3/grandparent1/parent1@10

grandgrandparent3/grandparent1/parent1/child1@11

I need to have the following data representation in the TreeView control:

grandparent1, 1

- parent1, 2,

- child3, 3

grandparent2, 4

- parent1, 5

- child1, 6

- child2, 7

grandgrandparent3, 8

- grandparent1, 9

- parent1, 10

- child1, 11

where the ID numerical value must be part of the TreeNode object for later retrieval and lookup in the element's data collection to display the entire element record in the ListView control, the node ID numbers need not be displayed in the TreeView control and are shown here for clarity only.

Here is an extended TreeNode class:

namespace ElementSearch

{

public class MyTreeNode : TreeNode

{

public uint \_ID { get; set; }

public MyTreeNode()

{

\_ID = 0;

}

public MyTreeNode(string text) : base(text)

{

\_ID = 0;

}

public MyTreeNode(string text, uint id, uint handle) : base(text)

{

\_ID = id;

}

public MyTreeNode(string text, MyTreeNode[] children) : base(text)

{

\_ID = 0;

Nodes.AddRange(children);

}

public MyTreeNode(MyTreeNode other) : base(other.Text)

{

\_ID = other.\_ID;

Checked = other.Checked;

}

}

}

The following two functions should work and are here to assist you in understanding the assignment better:

private void FillTreeView(TreeView treeView, List<List<string>> fileTokens)

{

var nodeLookup = new Dictionary<string, MyTreeNode>();

foreach (var lineTokens in fileTokens)

{

if (lineTokens.Count < 3)

continue;

uint.TryParse(lineTokens[0], out uint id);

string family\_hierarhy = lineTokens[1];

uint.TryParse(lineTokens[2], out uint handle);

var relatives = family\_hierarhy.Split('/').Select(relative => new MyTreeNode(relative, id, handle)).ToList();

treeView.Invoke(new Action(() =>

{

AddNode(treeView.Nodes, relatives, 0, nodeLookup);

}));

}

}

private void AddNode(TreeNodeCollection nodes, List<MyTreeNode> family, int index, Dictionary<string, MyTreeNode> nodeLookup)

{

if (index < family.Count)

{

var currentRelative = family[index];

var currentNodeKey = currentRelative.Text;

if (!nodeLookup.TryGetValue(currentNodeKey, out MyTreeNode currentNode))

{

currentNode = currentRelative;

nodes.Add(currentNode);

nodeLookup[currentNodeKey] = currentNode;

}

AddNode(currentNode.Nodes, family, index + 1, nodeLookup);

}

}

The data to be displayed in the ListView control are read from a text file'\_lst\_LogData\_elm\_all.txt' located in the data folder in the project directory where the ElementSearch.csproj file is located at the start of the program. The read data is stored in some optimally chosen C# language collection for that purpose.

string elementDataFilePath = Path.Combine(projectDirectory, "data", "\_lst\_LogData\_elm\_all.txt");

The data in the text file are stored in the following format, separated by the '@' delimiting character.

0@LONG\_ELM\_0@SHORT\_ELM\_0@0@0@0@aaaaa@000000000

1@LONG\_ELM\_1@SHORT\_ELM\_1@1@1@1@bbbbb@111111111

2@LONG\_ELM\_2@SHORT\_ELM\_2@2@2@2@ccccc@222222222

3@LONG\_ELM\_3@SHORT\_ELM\_3@3@3@3@ddddd@333333333

4@LONG\_ELM\_4@SHORT\_ELM\_4@4@4@4@eeeee@444444444

5@LONG\_ELM\_5@SHORT\_ELM\_5@5@5@5@fffff@555555555

6@LONG\_ELM\_6@SHORT\_ELM\_6@6@6@6@ggggg@666666666

7@LONG\_ELM\_7@SHORT\_ELM\_7@7@7@7@hhhhh@777777777

8@LONG\_ELM\_8@SHORT\_ELM\_8@1@8@8@iiiii@888888888

9@LONG\_ELM\_9@SHORT\_ELM\_9@2@9@9@jjjjj@999999999

10@LONG\_ELM\_10@SHORT\_ELM\_10@2@2@10@kkkkk@999999991

11@LONG\_ELM\_11@SHORT\_ELM\_11@3@3@9@hhhhh@999999992

12@LONG\_ELM\_12@SHORT\_ELM\_12@6@12@6@ggggg@999999993

The ListView control contains eight columns: ID, Long Name, Short Name, Element Type, Channel, Database, Location, and Handle, which match the order and the number of items in the row of the text file, e.g. 0@LONG\_ELM\_0@SHORT\_ELM\_0@0@0@0@aaaaa@000000000

Once a node in the TreeView control is selected (checked), the node's unique ID number is used to look up the entire element in the collection, and only then, if there is a match, display the data in the ListView control in the respective columns.Once a node in the TreeView control is unchecked, the respective node's data is removed from the ListView control.

Since this application must process massive datasets, where the TreeView has potentially thousands of nodes, each with thousands of children nodes, the data model needs to be separated from the UI using appropriate collections (data structures), e.g., List, Dictionary, HashSet, etc. to store and manipulate the underlying data. That way, the optimally chosen for that purpose collections are searched first, and then the UI controls are updated accordingly to display the filtered results.

Similarly, for the ListView control, the underlying data should be stored in a List or some other suitable fast-performing optimal collection and searched for the matching elements to display before displaying them. After obtaining the filtered data, update the ListView control accordingly.

namespace ElementSearch

{

public class NodeEntity

{

public uint ID { get; set; }

public string Name { get; set; }

}

public class ElementData

{

public uint ID { get; set; }

public string LongName { get; set; }

public string ShortName { get; set; }

public string ElementType { get; set; }

public string Channel { get; set; }

public string Database { get; set; }

public string Location { get; set; }

public uint Handle { get; set; }

}

}

Here are some function definitions that shall further assist you in creating an optimal solution. However, please use my verbal instructions to analyze the requirements and develop an optimal solution. The function definitions I am furnishing you with are here to assist you. In the end, I am letting you choose how to implement the solution

private IEnumerable<TreeNode> GetCheckedNodes(TreeNodeCollection nodes)

{

List<TreeNode> checkedNodes = new List<TreeNode>();

foreach (TreeNode node in nodes)

{

if (node.Checked && node.Nodes.Count == 0)

{

TreeNode fullPathNode = new TreeNode(node.FullPath);

fullPathNode.Tag = node;

checkedNodes.Add(fullPathNode);

}

checkedNodes.AddRange(GetCheckedNodes(node.Nodes));

}

return checkedNodes;

}

private void FindAndCheckNodes(TreeView treeView, string nameToFind)

{

foreach (TreeNode node in treeView.Nodes)

{

FindNodesByName(node, nameToFind);

}

}

private bool FindNodesByName(TreeNode parentNode, string nameToFind)

{

bool foundNode = false;

if (parentNode.Text.IndexOf(nameToFind, StringComparison.OrdinalIgnoreCase) >= 0)

{

parentNode.Checked = true;

foundNode = true;

if (parentNode.Parent != null)

{

parentNode.Parent.Expand();

}

else

{

parentNode.Expand();

}

}

foreach (TreeNode childNode in parentNode.Nodes)

{

bool childFound = FindNodesByName(childNode, nameToFind);

foundNode = foundNode || childFound;

}

return foundNode;

}

private void ClearTreeView(TreeView treeView)

{

foreach (TreeNode node in treeView.Nodes)

{

UncheckAndCollapseNodes(node);

}

}

private void UncheckAndCollapseNodes(TreeNode parentNode)

{

parentNode.Checked = false;

parentNode.Collapse();

foreach (TreeNode childNode in parentNode.Nodes)

{

UncheckAndCollapseNodes(childNode);

}

}

Before we proceed with the implementation, please summarize first what you understood from my requirements. It is paramount to understand very clearly what needs to be done first.

**ChatGPT 3.5 answer:**

Based on your requirements, I understand that you need assistance in developing a Windows Forms application using .NET 4.8 Framework that displays data in a TreeView control and a ListView control. The TreeView control contains nodes that may have children nodes, each with a checkbox, a text field storing the node's name, and a numeric field holding the node's positive unique ID number. The data for the TreeView control is read from a text file located in the project directory. The ListView control displays data read from another text file, with each row consisting of eight columns that match the order and the number of items in the row of the text file.

When a node in the TreeView control is selected (checked), its unique ID number is used to look up the entire element in the collection, and if there is a match, the data is displayed in the respective columns of the ListView control. If a node in the TreeView control is unchecked, the respective node's data is removed from the ListView control. To handle massive datasets, the data model needs to be separated from the UI using appropriate collections (data structures), e.g., List, Dictionary, HashSet, etc., to store and manipulate the underlying data.

To achieve this, you need to create an optimal solution that reads the data from the text files, displays it in the TreeView control, and updates the ListView control accordingly when a node is checked or unchecked. The solution should also allow filtering of the TreeView control by name and searching of the ListView control by element ID.

To accomplish this task, we will start by writing a pseudocode plan that will outline the steps necessary to achieve the desired outcome.

**ChatGPT 4 answer:**

Summary of Requirements:

1. Develop a Windows Forms (WinForms) application in .NET 4.8 Framework with a TreeView and a ListView control.
2. Populate the TreeView control using data from a text file "\_lst\_LogData\_dbs.txt". The data must be read line by line and parsed to create a hierarchical structure of nodes with checkboxes, node names, and unique ID numbers.
3. Create an extended TreeNode class called MyTreeNode with an additional property for storing the unique ID number.
4. Implement the provided FillTreeView and AddNode functions to populate the TreeView control.
5. Load data for the ListView control from a text file "\_lst\_LogData\_elm\_all.txt". The data must be stored in an appropriate collection for efficient searching and retrieval.
6. Define classes NodeEntity and ElementData to store the data for TreeView nodes and ListView elements.
7. When a node is checked in the TreeView control, search for the node's unique ID in the collection, and if found, display the data in the ListView control.
8. When a node is unchecked in the TreeView control, remove the respective node's data from the ListView control.
9. Optimize the data model by separating it from the UI and using appropriate collections for storing and manipulating data, such as List, Dictionary, HashSet, etc.
10. Provide additional helper functions for checking and unchecking nodes, finding nodes by name, and clearing the TreeView control.

Please confirm if the summary above accurately reflects your requirements, and I will proceed with the implementation.

Continue writing please

Given the requirements, here is the step-by-step plan in pseudocode for the implementation:

1. Initialize the main form with the TreeView and ListView controls.
2. Read the data file for the TreeView control: a. Read each line in "\_lst\_LogData\_dbs.txt". b. Parse the line into node ID, family hierarchy, and handle. c. Create a list of tokenized data for each line.
3. Populate the TreeView control using the FillTreeView function with the tokenized data.
4. Read the data file for the ListView control: a. Read each line in "\_lst\_LogData\_elm\_all.txt". b. Parse the line into ElementData properties. c. Store the parsed data in an appropriate collection for efficient searching and retrieval (e.g., Dictionary with ID as the key).
5. Add event handlers for the TreeView control: a. When a node is checked or unchecked, search the collection for the node's unique ID. b. If found, add or remove the respective element data in the ListView control based on the node's checked state.
6. Implement the provided helper functions for checking/unchecking nodes, finding nodes by name, and clearing the TreeView control.

Once the plan is confirmed, I will provide the actual C# code implementation.

Continue writing please

This C# code implements the MainForm with a TreeView and a ListView control. The **InitializeTreeViewAndListView** method initializes both the TreeView and ListView controls, adding necessary columns to the ListView and setting the required properties for both controls. The controls are then added to the form's Controls collection.

The **LoadTreeViewData** method reads the data from the "\_lst\_LogData\_dbs.txt" file and populates the TreeView control using the **FillTreeView** method. The **LoadListViewData** method reads the data from the "\_lst\_LogData\_elm\_all.txt" file and stores the element data in a dictionary (elementDataDict) for efficient look-up.

The **AddTreeViewEventHandlers** method adds an event handler for the TreeView's **AfterCheck** event. When a node in the TreeView control is checked or unchecked, the respective element is either added to or removed from the ListView control using the **AddElementToListView** and **RemoveElementFromListView** methods.

With the provided implementation, the MainForm class satisfies the requirements specified for loading, displaying, and updating data in the TreeView and ListView controls while ensuring optimal performance and memory usage.

**Prompt:**

I am experiencing a serious usability issue in my app. Once I uncheck a node that has inside a hierarchy of over 7, 000 nodes, both parents and children, my app stalls for 2-3 minutes before it responds. I want to provide you with entire code for you to identify the issue. Are you ready?

My application now does not do what it is supposed to do. It should display in the ListView control ALL checked nodes and once unchecked it should remove ALL unchecked nodes from the ListView. With the latest fix it displays only one node, regardless of its hierarchy of children. That really sucks.

**Prompt:**

I need to extend this app to do the following. First, look closely at the following four data sets, which are the contents of the four text files we use as application input, and write me please DONE when you finish analyzing them.

In three files, the data are arranged in the format: ID@Long Name:

\_lst\_LogData\_element\_type.txt:

0@Element\_Type\_1

1@Element Type\_1/Elm\_Name\_1

2@Elm\_Type\_1/Element\_Name\_2

3@Element\_Type\_1/Element\_Name\_3

4@Element\_Type\_2

5@Element\_Type\_2/Element\_Name\_1

6@Element\_Type\_2/Element\_Name\_2

7@Element\_Type\_2/Element\_Name\_3

8@Element\_Type\_3

9@Element\_Type\_3/Element\_Name\_1

10@Element\_Type\_3/Element\_Name\_2

11@Element\_Type\_3/Element\_Name\_2/Element\_Leaf\_1

12@Element\_Type\_3/Element\_Name\_2/Element\_Leaf\_2

\_lst\_LogData\_channel.txt:

0@Channel\_1

1@Channel\_1/Name\_1

2@Channel\_1/Name\_2

3@Channel\_1/Name\_3/Leaf\_1

4@Channel\_2

5@Channel\_2/Name\_1

6@Channel\_2/Name\_1/Leaf\_1

7@Channel\_2/Name\_2

8@Channel\_3

9@Channel\_3/Name\_1

10@Channel\_3/Name\_2

11@Channel\_3/Name\_2/Leaf\_1

12@Channel\_3/Name\_2/Leaf\_2

\_lst\_LogData\_database.txt:

0@Database\_1

1@Database\_1/Name\_1

2@Database\_1/Name\_2

3@Database\_1/Name\_3

4@Database\_2

5@Database\_2/Name\_1

6@Database\_2/Name\_2/Leaf\_1

7@Database\_2/Name\_2/Leaf\_2

8@Database\_3

9@Database\_3/Name\_1

10@Database\_3/Name\_2

11@Database\_3/Name\_3/Leaf\_1

12@Database\_3/Name\_3/Leaf\_2

In \_lst\_LogData\_element\_all.txt the data are arranged in the format: Line\_ID@Long Name@Short Name@Element Type@Channel@Database@Location@Handle

0@LONG\_ELM\_0@SHORT\_ELM\_0@0@0@0@aaaaa@000000000 1@LONG\_ELM\_1@SHORT\_ELM\_1@1@1@1@bbbbb@111111111 2@LONG\_ELM\_2@SHORT\_ELM\_2@2@2@2@ccccc@222222222 3@LONG\_ELM\_3@SHORT\_ELM\_3@3@3@3@ddddd@333333333 4@LONG\_ELM\_4@SHORT\_ELM\_4@4@4@4@eeeee@444444444 5@LONG\_ELM\_5@SHORT\_ELM\_5@5@5@5@fffff@555555555 6@LONG\_ELM\_6@SHORT\_ELM\_6@6@6@6@ggggg@666666666 7@LONG\_ELM\_7@SHORT\_ELM\_7@7@7@7@hhhhh@777777777 8@LONG\_ELM\_8@SHORT\_ELM\_8@8@8@8@iiiii@888888888 9@LONG\_ELM\_9@SHORT\_ELM\_9@9@9@9@jjjjj@999999999 10@LONG\_ELM\_10@SHORT\_ELM\_10@9@9@9@kkkkk@999999991 11@LONG\_ELM\_11@SHORT\_ELM\_11@9@9@9@hhhhh@999999992 12@LONG\_ELM\_12@SHORT\_ELM\_12@12@12@12@ggggg@999999993

I was hoping you could modify the current C# Windows Forms application so that when a leaf node in a TreeView control is selected, its underlying ID is searched in the respective column in the dataset (dictionary) obtained from the \_lst\_LogData\_element\_all.txt file. A selected node’s ID in the treeViewElementType control is searched in the Element Type column, a selected node’s ID in the treeViewChannel control is searched in the Channel column, and a selected node’s ID in the treeViewDatabase control is searched in the Database column. If and only if the node’s ID is found in the appropriate column, then the found ID is used to retrieve the record from the dictionary prefilled with data from ‘\_lst\_LogData\_element\_all.txt’ file and is displayed in the ListView.

Also, I need the numerical data in the Element Type, Channel, and Database columns to be converted for a display to text corresponding to the Long Name from the respective dataset.

That is, for example, if node ‘11@Element\_Type\_3/Element\_Name\_2/Element\_Leaf\_1’ is selected, then its second token ‘Element\_Type\_3/Element\_Name\_2/Element\_Leaf\_1’ is looked up in the dataset obtained from the ‘\_lst\_LogData\_elment\_type.txt’ file based on the selected ID number and that token is displayed in the listViewElements control instead of just a numeric figure. The same logic applies to Channel and Database columns.

**Prompt:**

There are three text boxes that are used to search data in the respective TreeView controls. The textBoxElementType is used to search the treeViewElementType, the textBoxChannel is used to search the treeViewChannel and the textBoxDatabase is used to search the treeViewDatabase based on the user-supplied text that is at least 3 characters long in the respective text box when the Enter key is hit. If there is a match, then the node with the matching name is marked checked and its data is displayed in the ListView in the manner we currently have. Can you implement the methods for me please.

**Prompt:**

By the way, before I give the code I want to tell you that I have also added 3 checkboxes, namely checkBoxElementType, checkBoxChannel and checkBoxDatabase that I want to use to check and uncheck all the nodes in the respective TreeView control, that is in treeViewElementType, treeViewChannel and treeViewDatabase. This functionality needs to be added as well to the existing code that I am about to provide you with along with the elimination of the duplicate entries in the ListView control based on the ID column numbers. I am also uncertain which event type to choose to accomplish that. Here are some samples: checkBoxElementType\_CheckedChanged or checkBoxChannel\_CheckStateChanged or checkBoxDatabase\_Click

**Prompt:**

I have implemented the following functionality but I am unhappy with it since it is inefficient. I believe that using some sort of collection behind the ListView control to avoid duplicate entries should improve performance. That is, the app will store the elements in an optimized for that purpose collection, i.e. Hash set behind the scenes that has instant O(1) search time complexity and use it in the business logic to ensure only non-duplicate entries in the ListView control. What do you think?

**Prompt:**

Thank you. You are wonderful! I have also added a checkBoxElementType that once checked should check all nodes, possibly recursively in the treeViewElementType, and once uncheck should uncheck all the nodes. Can you implement this functionality for me please?

**Prompt:**

For some reason my app does not collapse TreeView nodes once I hit the clear button. Moreover, after all the modifications I feel that the app must be optimized because I found duplicated functionality. I want to give you the entire code again for you to thoroughly analyze it and optimize it with respect to performance. Please remember that you are a brilliant and very experienced C# software engineer that specializes in Microsoft .NET 4.8 Framework for building Windows Applications. Please forget everything we have discussed so far and let's start all over again. I will give you now the entire code in 2 parts. Wait until I have supplied you the entire code via two prompts. I am open for your optimization suggestions. Feel free to add additional code or remove redundant code as you deem necessary.

Microsoft .NET 4.8 Framework does not recognize this style and removes the code automatically:

You are a talented and experienced C# software engineer that specializes in Microsoft .NET 4.8 Framework for building Windows Applications. I am giving you Windows Forms code in 2 parts for thorough analysis. Wait until I have supplied you the entire code via two prompts.

**Prompt:**

You are an experienced C programming language software engineer. Please refactor the following code to make it read data from pipeline in one thread and print in another. Please make sure to use proper synchronization mechanisms.

**Prompt:**

I am developing a Windows Forms (WinForms) in .NET 4.8 Framework that would allow me to display and search data. It has three TreeView controls. Each TreeView has nodes. Each node may or may not have children nodes. Each node, regardless whether it is a parent node or a child node, has a checkbox. Each node has a text field that stores the node's name and a numeric field that stores the node's ID number.

The nodes in the TreeView controls are filled out with data from three respective text files located in the data folder, namely data\ \_lst\_LogData\_element\_type.txt, data\ \_lst\_LogData\_channel.txt, data\ \_lst\_LogData\_database.txt in the project directory.

For example, given the following hierarchy, which is read from a text file line by line where the number represents node ID number and the text separated by the @ delimiting character represents the node's name and it is respective location in the family hierarchy:

0@Elm\_Type\_1

1@Elm\_Type\_1/Elm\_Name\_1

2@Elm\_Type\_1/Elm\_Name\_2

3@Elm\_Type\_1/Elm\_Name\_3/Elm\_Leaf\_1

4@Elm\_Type\_2

5@Elm\_Type\_2/Elm\_Name\_1

6@Elm\_Type\_2/Elm\_Name\_2

7@Elm\_Type\_2/Elm\_Name\_3

8@Elm\_Type\_3

9@Elm\_Type\_3/Elm\_Name\_1

10@Elm\_Type\_3/Elm\_Name\_2

11@Elm\_Type\_3/Elm\_Name\_2/Elm\_Leaf\_1

12@Elm\_Type\_3/Elm\_Name\_2/Elm\_Leaf\_2

I need to have the following hierarchy consisting of TreeNodes in the TreeView control. Here it consists of 3 levels but the number of levels is unlimited:

Elm\_Type\_1

- Elm\_Name\_1

- Elm\_Name\_2

- Elm\_Name\_3

-- Elm\_Leaf\_1

Elm\_Type\_2

- Elm\_Name\_1

- Elm\_Name\_2

- Elm\_Name\_3

Elm\_Type\_3

- Elm\_Name\_1

- Elm\_Name\_2

- Elm\_Name\_2

-- Elm\_Leaf\_1

-- Elm\_Leaf\_2

The ID number must be part of the TreeNode object for later retrieval and usage and I have taken care of it by extending the TreeNode class and adding an ID member to it as in public class MyTreeNode : TreeNode

Unfortunately, my current code builds the following incorrect hierarchy:

Elm\_Type\_1

- Elm\_Name\_1

- Elm\_Name\_2

-- Elm\_Leaf\_1

-- Elm\_Leaf\_2

- Elm\_Name\_3

Elm\_Type\_2

Elm\_Type\_3

Some of my current code to assist you figure out where the defect is:

public partial class ElementSearch : Form

{

private Dictionary<uint, string> elementTypeById = new Dictionary<uint, string>();

private void LoadData()

{

string projectDirectory = Directory.GetParent(Environment.CurrentDirectory).Parent.FullName;

string elementTypeFilePath = Path.Combine(projectDirectory, "data", "\_lst\_LogData\_element\_type.txt");

string[] filesPaths = { elementTypeFilePath };

var fileTokens = filesPaths.Select(ReadTextFile).ToArray();

FillTreeView(treeViewElementType, fileTokens[0]);

FillDictionary(elementTypeById, fileTokens[0]);

}

private List<List<string>> ReadTextFile(string filePath)

{

var fileTokens = new List<List<string>>();

using (var reader = new StreamReader(filePath))

{

string line;

while ((line = reader.ReadLine()) != null)

{

var tokens = line.Split('@').Where(token => !string.IsNullOrEmpty(token)).ToList();

fileTokens.Add(tokens);

}

}

return fileTokens;

}

private void FillDictionary(Dictionary<uint, string> dict, List<List<string>> fileTokens)

{

foreach (var lineTokens in fileTokens)

{

if (lineTokens.Count != 2)

continue;

uint.TryParse(lineTokens[0], out uint id);

dict[id] = lineTokens[1];

}

}

private void FillTreeView(TreeView treeView, List<List<string>> fileTokens)

{

var nodeLookup = new Dictionary<string, MyTreeNode>();

foreach (var lineTokens in fileTokens)

{

if (lineTokens.Count != 2)

continue;

uint.TryParse(lineTokens[0], out uint id);

string family\_hierarhy = lineTokens[1];

var relatives = family\_hierarhy.Split('/').Select(relative => new MyTreeNode(relative, id)).ToList();

AddNode(treeView.Nodes, relatives, 0, nodeLookup);

}

}

private void AddNode(TreeNodeCollection nodes, List<MyTreeNode> family, int index, Dictionary<string, MyTreeNode> nodeLookup)

{

if (index < family.Count)

{

var currentRelative = family[index];

var currentNodeKey = currentRelative.Text;

if (!nodeLookup.TryGetValue(currentNodeKey, out MyTreeNode currentNode))

{

currentNode = currentRelative;

if (this.InvokeRequired)

{

this.Invoke(new Action(() => nodes.Add(currentNode)));

}

else

{

nodes.Add(currentNode);

}

nodeLookup[currentNodeKey] = currentNode;

}

AddNode(currentNode.Nodes, family, index + 1, nodeLookup);

}

}

}

Please suggest how to fix my code to ensure that the TreeView hierarchy is built correctly.

Your new code generates the following incorrect hierarchy:

Elm\_Type\_1

- Elm\_Name\_1

- Elm\_Name\_2

- Elm\_Name\_3

Elm\_Type\_2

- Elm\_Name\_1

- Elm\_Name\_2

- Elm\_Name\_3

Elm\_Type\_3

- Elm\_Name\_1

- Elm\_Name\_2

- Elm\_Name\_2

-- Elm\_Leaf\_1

- Elm\_Name\_2

-- Elm\_Leaf\_2

instead of the required correct hierarchy

Elm\_Type\_1

- Elm\_Name\_1

- Elm\_Name\_2

- Elm\_Name\_3

-- Elm\_Leaf\_1

Elm\_Type\_2

- Elm\_Name\_1

- Elm\_Name\_2

- Elm\_Name\_3

Elm\_Type\_3

- Elm\_Name\_1

- Elm\_Name\_2

- Elm\_Name\_2

-- Elm\_Leaf\_1

-- Elm\_Leaf\_2

Thank you for addressing this issue. The hierarchy is correct now, but the node ID numbers are not. I need the displayed nodes to have correct ID numbers as in:

0@Elm\_Type\_1

1@Elm\_Type\_1/Elm\_Name\_1

2@Elm\_Type\_1/Elm\_Name\_2

3@Elm\_Type\_1/Elm\_Name\_3/Elm\_Leaf\_1

4@Elm\_Type\_2

5@Elm\_Type\_2/Elm\_Name\_1

6@Elm\_Type\_2/Elm\_Name\_2

7@Elm\_Type\_2/Elm\_Name\_3

8@Elm\_Type\_3

9@Elm\_Type\_3/Elm\_Name\_1

10@Elm\_Type\_3/Elm\_Name\_2

11@Elm\_Type\_3/Elm\_Name\_2/Elm\_Leaf\_1

12@Elm\_Type\_3/Elm\_Name\_2/Elm\_Leaf\_2