# HappyTree API

Handle your tree of Java Model Objects.

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## Getting Started

### What is it?

The HappyTree API is a Java API for model objects representation in a **tree hierarquical structure**. It depicting what Javascript DOM depict, but for Java. Here, you deal with model objects (POJO) that generally represent entities in a problem domain, instead of HTML DOM objects.

A hierarchical structure, in the context of the HappyTree API, consists of a set of the same type of model objects that relate to each other, either physically or logically, and that these objects have in this relationship, a hierarchical tree behavior.

In addition, the HappyTree API transforms a linear structure of objects that behave like nodes in a tree, but which are not, into a real tree structure. We call this process of **API Transformation Process (ATP)**.

Therefore:

> *"HappyTree is a data structure API designed for the Java programming language that consists of transforming linear structures of model objects (POJO) into a tree structure and allowing its handling."*

### What is the objective?

The HappyTree API provides interfaces to the API client for three primaries and clear objectives:

1. Create element trees and save them within sessions.

2. Create element trees through the **API transformation process** and save them within sessions.
3. Handle tree elements in order to move, copy, cut, remove and update or persist elements.

The first purpose occurs when you want to create a simple empty tree of elements, so that tree is available to be handled as you wish.

The second purpose is suitable for situations in which the API client needs to transform a collection of plain objects of which there is a tree logical relation between them, but which is not being represented structurally as a tree. In that, we named **API transformation process**.

The last one represents the free handling of elements within the tree, after it has been created.

### When to use?

Let's say you work on a Java project for a company, preferably a legacy project, on which the system was developed many years ago. Then someone assigned you a ticket to adjust the system menu. A sub menu item needs to be relocated to another menu category. Therefore, you go to the database and find something like:

| MENU_ID | MENU_LABEL | MENU_PARENT_ID | MENU_DESCRIPTION |
|---|---|---|---|
| 105 | Administration | null | |
| 110 | Control Panel | 105 | ... |
| 302 | Users | null | |
| 321 | My Profile | 302 | ... |
| 322 | Access Control | 302 | ... |

The purpose of the ticket would be to relocate the "Access Control" menu to stay within the Administrator menu.

However, because it is a legacy project, the development team did not take the necessary care, and when loading this structure from the database to the respective Java “Menu” object, the development team did not physically treat this entire structure as tree menus. Therefore, the object in question looks like this:

```
public class Menu {
	private Integer menuId;
	private String menuLabel;
	private Integer menuParentId;
	private String menuDescription;

	//An empty constructor.
	public Menu() {
	}

	//getters & setters
}
```

As each object of the class above represents a menu item, we do not have here, in terms of Object-oriented, a defined tree structure, but rather a structure that came the way it is in the database, that is, a relational/linear structure.

You end up discovering that you did not want this, because in addition to the structure not being

physically like a tree, you will probably have some extra work to implement recursive methods and other methods to perform operations for the nodes of the menu tree.

Therefore, here would be a good circumstance to use the HappyTree API.

The above structure would be transformed by the HappyTree API (through the API Transformation Process) into:

```
public class Element<Menu> {
	private Collection<Element<Menu>> children;

	//...
}
```

With the transformation performed, each “Element” object encapsulates its respective “Menu” object within itself, and each “Element” object is physically in a position in the tree, thus representing a tree node.

In addition, each element can have several other elements within it, such as children, and each child have other children, and so on, recursively representing an entire complete tree.

After the tree is built, you can relocate the desired menu item using the interfaces provided by the HappyTree API, without the need to implement any additional code. See below, how to use.

### How to use

Continuing the example above and as already mentioned, there is no need to implement any additional code to

relocate the desired menu. Just add the following annotations to the “Menu” class:

```
@Tree
public class Menu {
	@Id
	private Integer menuId;
	private String menuLabel;
	@Parent
	private Integer menuParentId;
	private String menuDescription;

	//An empty constructor.
	public Menu() {
	}

	//getters & setters
}
```

**@Tree**

Indicates that the class can be transformed, by the API Transformation Process, into a tree node.

**@Id**

Unique and non-null identifier of the object to be transformed.

**@Parent**

Identifier of the parent object to which the current object will bind at the transformation moment.

There are some conditions for the API Transformation Process to be successful:

- The three annotations must be present in the class to be transformed;
- The value of the attribute annotated by **@ID** must be mandatory, while the attribute annotated by **@Parent** can be null, or point to a non-existent

parent. This **@Parent** attribute is responsible for moving or not the object to the root level of the tree, if it is null or not found.
- The attribute annotated by **@ID** must be of the same type as the attribute annotated by **@Parent**.

From this point on, after just putting these annotations to the class attributes, you already have everything to transform your linear structure into a real tree structure.

### Your First Code Snippet

To initialize the menu tree in the example above, and any other type of tree, we use a code snippet that is quite common and will always be used at any tree initialization:

```
Collection<Menu> menus = myObject.getMenuFromDatabase();
TreeManager manager = HappyTree.createTreeManager();
TreeTransaction transaction = manager.getTransaction();
transaction.initializeSession("MyFirstHappyTree", menus);
```

From the code above, your tree is already built and has a session identifier named "myFirstHappyTree". Every tree (session) initialized is assigned a unique and non-null session identifier. We will talk about these concepts in more detail later.

However, it remains to fulfill the objective of the ticket assigned to you. Although you already have the tree built, it remains to reallocate the "Access Control" menu from "Users" to "Administration".

As we already know, through the database in the example above, the menu item with the label "Access Control"

has the **@ID 322** and the menu item "Administration" has the **@ID 105**. With that in mind, just do the following:

```
Element<Menu> administration = manager.getElementById(105);
Element<Menu> accessControl = manager.getElementById(322);
manager.cut(accessControl, administration);
```

Alternatively:

```
Element<Menu> accessControl = manager.cut(322, 105);
```

Okay, now you have solved the ticket!

## Requirements

HappyTree is an API that strives for simplicity and that acts in a very specific way on Java model objects, when they have a tree behavior. Such simplicity is also reflected in the requirements.

There are only three basic requirements:

- Java 1.8;
- Maven 3.6.3;
- The Java and Maven environment variables must be well configured ($JAVA_HOME, $MAVEN_HOME and $PATH).

Optional (It is optional, but highly recommended to fix code issues):

- SonarLint.

## Download

You can import the HappyTree API via:

- Maven
- JAR

In the next chapter, you will see the HappyTree API architectural specification. You will understand what the functional interfaces are and what they are for, the structure and behavior of the API as well as the lifecycle and states of the objects, and to conclude, the API Transformation Process.

## Architectural Specification

Although until now you are able to use the HappyTree API with some ease, but it is recommended that you read this chapter to have a complete understanding of all aspects of the HappyTree API.

We will adopt a Top-Down approach here, starting with the exposed interfaces and its functionalities, and then we will explain the structural and behavioral composition of the API, in order to conclude with the technical details. We promise it will not be tiring reading!

### Functional Architecture

The HappyTree API provides for the API client four interfaces with different responsibilities.

#### Interfaces Scope

- **TreeSession**

  Responsible for storing the trees. Each session has a unique, non-null identifier and stores a collection of Element interface (in a hierarchical tree structure), representing the tree itself. Only it is possible to run the most of operations related to elements/trees if the current tree session associated to the transaction is active.

- **TreeTransaction**

  Object responsible for managing the sessions. This object can create, activate, deactivate and destroy stored sessions. It is through

this object that the ***TreeManager*** interface performs operations on trees. For this, it is necessary that the transaction is pointing to a session and that this session is active.
The transaction acts as a kind of selector, allowing the ***TreeManager*** object to perform operations on one session at a time.

Therefore, when the API client performs an operation like *cut()* as in the example above, it is doing this operation on a predetermined tree that was chosen through a transaction.

There are two ways to indicate to the transaction a tree that this object should reference. The first is through the *initializeSession()* that automatically, after the initialization (creation) of the session, the transaction already references the created session. The second is through *sessionCheckout()*, in which the API client chooses a tree in memory that must be referenced by the transaction.

- **Element**

  An element represents a node in a tree. It can have none or many other elements within it, such as children, and each child, likewise, can have several other elements, and so on.

  Beyond this, each element has a unique and non-null ***@Id*** and a nullable ***@Parent***,

representing the parent identifier which the element references. If the parent is a not found element or even null, then the element will stay in the root level of the tree.

In the **API Transformation Process**, it is this object that will encapsulate the annotated object that was used at the initialization of the session, placing the objects of the linear structure, which were transformed, in the correct physical location within the tree, contained within their respective elements (tree nodes).

This object has a defined lifecycle, which will be explained later.

- **TreeManager**

  Object responsible for performing operations on trees. It is through ***TreeManager*** that you will be able to create, cut, copy, remove, update and persist elements about a given tree session that was selected through a transaction.

  All ***TreeManager*** operations need a transaction referencing an active session, otherwise a ***TreeException*** exception will be thrown.

Therefore, all of these interfaces are related as follows:

***TreeManager (invokes) -> TreeTransaction (to store) -> TreeSession (that contains) -> Element***

In addition to these provided interfaces to the API client, other classes are also exposed to be used:

- **HappyTree**

  Final class and not instantiable. This class is the one that gives the initial start to use the HappyTree API. As shown at the beginning of this documentation, it is only intended to return instances of ***TreeManager***, working like this, as a *Helper* class:

  ```
  TreeManager manager = HappyTree.createTreeManager();
  ```

- **TreeException**

  Exception class associated with the HappyTree API. In any specification violation, this exception will be thrown.

- **Annotations**

  The annotations ***@Tree***, ***@Id*** and ***@Parent*** were exemplified at the beginning of this documentation. Should only be used within the context of the **API Transformation Process**.

All of these classes and interfaces are the ones that are exposed and the API client can use.

### Interface Methods

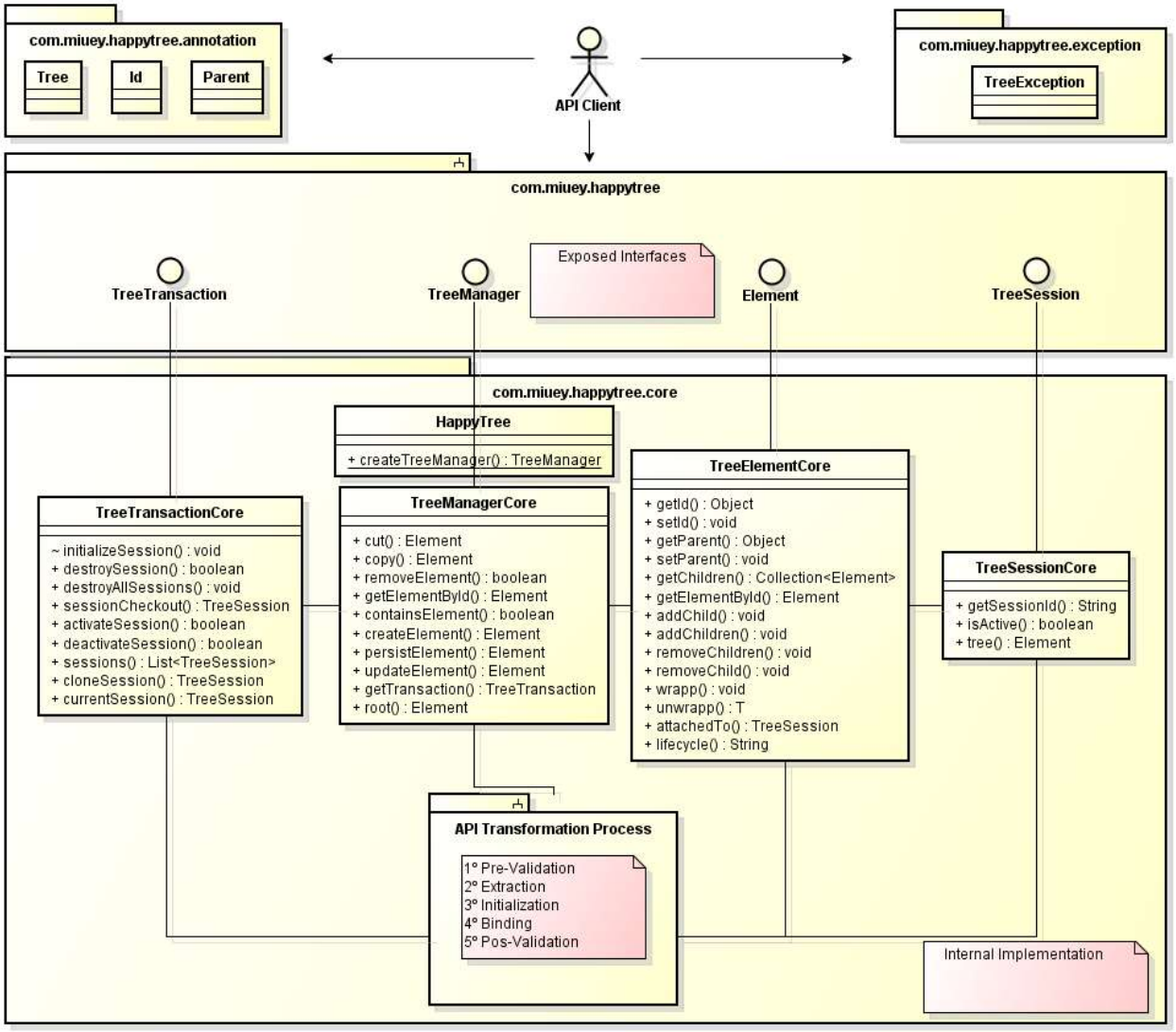
To see the list of interface methods, just enter this link.

### Application Architecture

Going down a little more in the Top-Down approach, now we will see a little more detail in the general architecture of the HappyTree API, but still maintaining a certain level of abstraction.

### General Architecture

In the image below, the general architecture of the HappyTree API is represented as well as the class packages and their responsibilities.




The HappyTree API has some packages, but two of them can be considered "main":

- **com.miuey.happytree**

  This package is the package from which the API client will be able to view and use the exposed interfaces. Also, this package only contains interfaces that must be exposed as functionalities for the API client. Therefore, everything contained here must be public.

The package contains the interfaces already talked about here:

- TreeTransaction;
- TreeManager;
- Element;
- TreeSession.

- **com.miuey.happytree.core**

  This package is where the actual implementation of these exposed interfaces are, in addition to implementing the ***Element*** object's lifecycle (it will be seen later) and the **API Transformation Process** phases. It contains several classes that assist in implementation, such as factories, Utils & Helpers, validators, message repositories, etc, but for internal use only.

  This package is internal. Because it is internal, this package should not be visible to the API client, with the exception of the ***HappyTree*** class, which is the class responsible for the API's entry point.

Below are the other packages:

- **com.miuey.happytree.annotation**

  This package is responsible for only store the annotations that will be used in the **API Transformation Process**. These annotations will

determine the identifier, the parent and the object's own class (the annotated class) that will be transformed into an ***Element*** object by the HappyTree API, representing a node of the tree. This package is public and the annotations are, as already mentioned:

- ***@Tree***;
- ***@Id***;
- ***@Parent***.

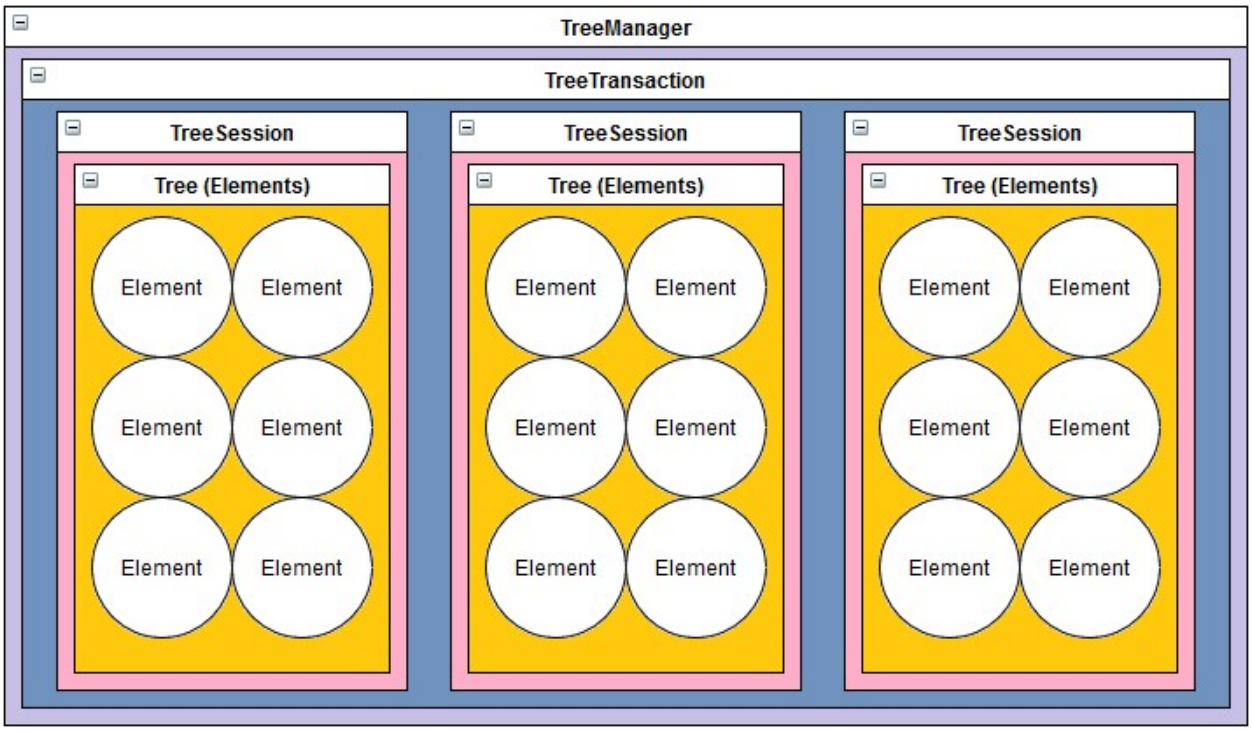
- **com.miuey.happytree.exception**

  This package will keep the ***TreeException*** class, threw in case an error occurs. This package is public, as the API client needs to handle this exception.

### Structural Composition

An object of ***Element*** type represents a node in a tree. A tree can only exist within a previously initialized session (***TreeSession***). To initialize a session, the API client needs to invoke an object that represents a session transaction, this object is known as ***TreeTransaction***. However, the transaction can only be recovered from within a manager, which implements the ***TreeManager*** interface, provided to the API client.

We conclude that: every ***Element*** is inserted into a ***TreeSession***, which in turn is manipulated within a ***TreeTransaction*** and finally recovered by a ***TreeManager***.



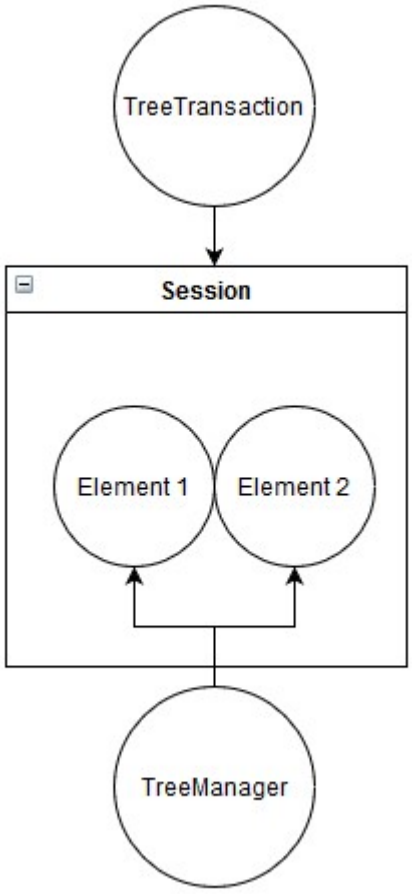

### Behavioral Composition

The HappyTree API allows the API client to use it under two provided main entities: the manipulation of elements in a tree, and the same manipulation of these trees linked to sessions. Each tree has its respective owner, and no other owner can handle trees other than his own. Therefore, for this protection, the session mechanism was created, where each element has a unique identifier in the tree, as well as a session has its own identifier within all open sessions in the transaction.

Therefore, the relationship between ***Element*** and ***TreeSession*** objects is intrinsic. The other two types of objects, ***TreeManager*** and ***TreeTransaction***, available to the API client, are precisely the ***Element*** and ***TreeSession*** manipulation objects respectively.

However, it is worth noting that the current session must always be active in order to handle the tree. This is the first check that the HappyTree API does. You can have several active sessions, but the ***TreeTransaction*** object can only work with one session at a time, which is the session chosen by the API client by invoking the ***TreeTransaction.sessionCheckout()*** method.

Thus, we see that there are two main entities (***Element*** and ***TreeSession***) and two entities (***TreeManager*** and ***TreeTransaction***) responsible for handling the main entities.



## Technical Architecture

Now that you know the main interfaces and how they relate, and also how objects of these interfaces are structured and their behavior, we can now dive into the more technical details of the HappyTree API.

We will start to explain the contexts, and then we will talk about the phases of using the API. With these two concepts in mind, we will see at the lifecycle of ***Element*** objects.

All of this initial explanation is very important for you to understand why you sometimes got an exception threw. This whole lifecycle concept of the Element within the tree is the fundamental basis for using the HappyTree API fully.

After that, we will see the states of the session, the specifications and necessary validations that HappyTree API does.

To conclude, we will explain in theory, how the **API Transformation Process** works, converting a list of linear objects in objects assembled like a real tree.

## Contexts

The HappyTree API is intended to manage object trees, however, it has no responsibility for the changes you make to these objects, which represent the nodes in the tree.

Consider the code below:

```
TreeManager manager = HappyTree.createTreeManager();
TreeTransaction transaction = manager.getTransaction();

Collection<Directory> directories = someObject.getDirectoryTree();

transaction.initializeSession("DirectoryTree", directories);

Element<Directory> winamp = manager.getElementById(winampId);
Element<Directory> programFiles = manager.getElementById(programFilesId);

programFiles.addChild(winamp);

//True or False?
manager.containsElement(programFiles, winamp);
```

Is the return of the last line ***true*** or ***false***?

Does the “programFiles” directory really have the “winamp” directory inside it, as a child, in the “DirectoryTree” session?

The answer is no. Although the "programFiles" object actually has the "winamp" object inside it, in the "DirectoryTree" session this change is not synchronized yet, because as previously said, the HappyTree API has no responsibility for the changes you apply to tree objects.

What actually happens when you get an element from an already assembled tree is that you actually receive a clone of the element. The real instance of the element is never returned, just clones of elements. Since the returned element can have several children inside, they are all "mirrored", thus, they are identical copies of the elements that are within the tree session.

Therefore, there are two ways to complete the code above in order to move the "winamp" directory into "programFiles" inside of the “DirectoryTree” session:

```
manager.updateElement(programFiles);
```

Or just invoke the method below without applying changes directly to the element

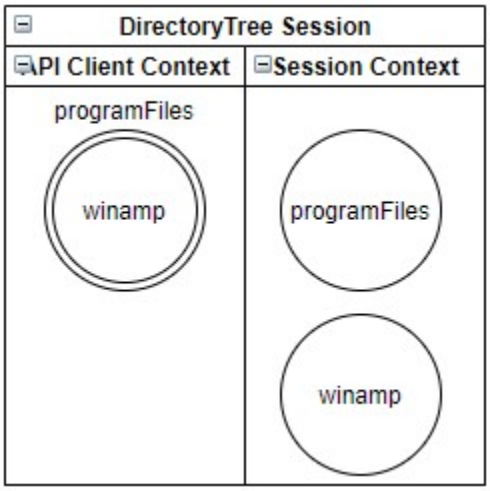
```
manager.cut(winamp, programFiles);
```

Note: when a tree change occurs through the TreeManager interface, it is not necessary to update the element.

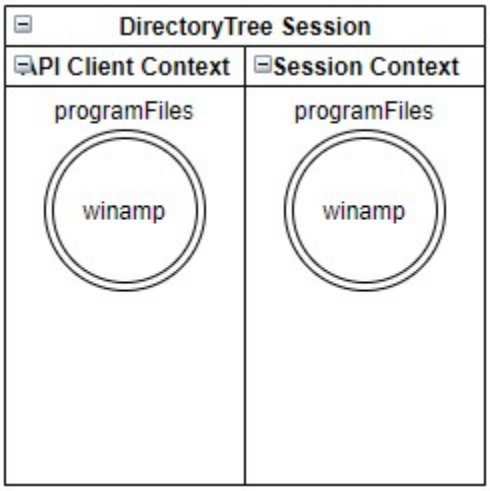
**Every change via TreeManager is automatically synchronized to the tree.**

With all that has been said so far, it is clear that there are two contexts. Understands this as perspectives: the API client's perspective and the session (the tree) perspective. So, in relation to the example above, we have the following:

**Before synchronization.**



**After synchronization (by update or some TreeManager method).**




*Be careful with object references*

After synchronization, in the example above, you have to ensure that your variables "programFiles" and “winamp” have their references updated, so as not to reference the previous state to the synchronization.

```
TreeManager manager = HappyTree.createTreeManager();
TreeTransaction transaction = manager.getTransaction();

Collection<Directory> directories = someObject.getDirectoryTree();

transaction.initializeSession("DirectoryTree", directories);

Element<Directory> winamp = manager.getElementById(winampId);
Element<Directory> programFiles = manager.getElementById(programFilesId);

programFiles.addChild(winamp);
manager.updateElement(programFiles);

/*
 * Still false at this point, despite the update. It is necessary to update the
 * reference of the programFiles and winamp variables.
 */
manager.containsElement(programFiles, winamp);
winamp = manager.getElementById(winampId);
programFiles = manager.getElementById(programFilesId);

//Now it is true.
manager.containsElement(programFiles, winamp);
```

The API client also needs to take special care in the immediate return of methods.

```
TreeManager manager = HappyTree.createTreeManager();
TreeTransaction transaction = manager.getTransaction();

Collection<Directory> directories = someObject.getDirectoryTree();

transaction.initializeSession("DirectoryTree", directories);

Element<Directory> winamp = manager.getElementById(winampId);
Element<Directory> programFiles = manager.getElementById(programFilesId);

programFiles.addChild(winamp);

manager.updateElement(programFiles);

/*
 * It is false because it is invoking the containsElement(Object, Object)
 * method instead of containsElement(Element, Element).
 */
manager.containsElement(manager.getElementById(programFilesId),
             manager.getElementById(winampId));
```

In the code example above, the API client intended to invoke the version of the *cut(Element, Element)* method but ended up invoking *cut(Object, Object)*. This is another version of the *cut()* method that takes ***Object*** as a parameter, instead of ***Element***. This ***Object*** represents the **@Id** of the element.

This is because of the immediate return of the *getElementById()* method within the *containsElement()* method. As the HappyTree API works with Java reflection, in runtime the JVM associates the return directly with ***Object***.

Therefore, it is recommended to assign the return of the method to a variable in order to use it, instead of using immediate return.

### Phases

Now that you know very well about the two contexts of the HappyTree API, it is much easier to recognize the execution phases. The following description is equivalent to either a new tree created from scratch or a tree built through the **API Transformation Process**, because these phases are measured after the session initializes.

There are three stages of execution. These stages have no direct implication of the API usage, thus serving as a purely informative feature, to facilitate the understanding of the lifecycle of the ***Element*** objects within the sessions.

| Phase | Method | Description |
|---|---|---|
| Initial Phase | getElementById() | Occurs when the API client get the element. The returned element has not yet undergone any changes by the API client. |
| Usage Phase | createElement(), addChild(), setId(), removeChild(), wrap(), etc. | Occurs when the API client applies a change, however small, to the state of the element that is returned from the previous phase. |
| Synchronization Phase | persistElement(), updateElement() | For the changes in the previous phase to take effect, it is necessary to synchronize them with the tree session, using the indicated methods. After that, both contexts are matched. |

### Element Lifecycle

The concepts of contexts and phases here were just for you had better understand the life cycle of the elements in the HappyTree API. We now present the lifecycle states as well as their descriptions.

When you get an element from a tree session, you have in your hands what we usually call of an **attached** element to the tree. An **attached (ATTACHED)** element

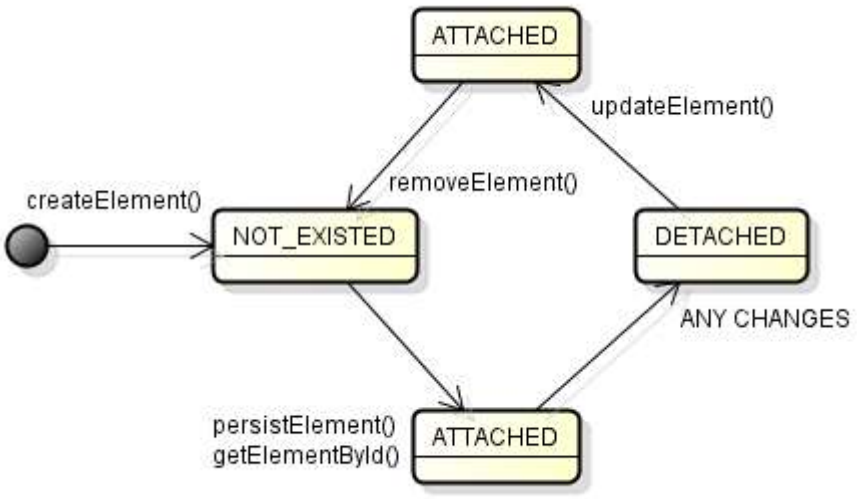
represents exactly the faithful copy of the element in relation to the session context, that is, you now, in your context, in the context of the API client, have an element that is a mirror of what is in the tree session.

When you decide to want to change something in that element that you got, it means that a copy of that element, which was identical to the element of the session context, will no longer be. To this state, we call it **detached (DETACHED)**, because the element is no longer synchronized with the tree.

Finally, you decide that this element is no longer useful to the current tree, so you decide to remove it. When removing an element from the tree, in the context of the tree session, we say that the element in question **not exists (NOT_EXISTED).**

Therefore, the cycle is repeated, from the moment of creating a new element or capturing an existing one, until its possible removal.

Note: **when creating an element from scratch, you are creating an element that does not yet belong to the tree, so its state assumes the value of nonexistent (NOT_EXISTED).**




### Session States

The object of the ***TreeSession*** interface is intended to represent a tree of elements. When we say something related to the session or the tree, both concepts have the same meaning, since a session object has the entire structure of the tree within it.

As mentioned at the beginning of this documentation, the transaction can only work with one session at a time. If you want to select sessions, just call the *sessionCheckout*() method provided by the ***TreeTransaction*** interface. However, the API client has to make sure that the session he wants to handle is active, otherwise, a ***TreeException*** will be threw, and this validation is done in almost all methods of the ***TreeManager*** object.

Basically, there are only three possible states of a session:

- Activated

  The session exists in memory and it is enabled to be handled.

- Deactivated

  The session exists in memory and it is not enabled to be handled. You cannot handle the tree, through the ***TreeManager*** methods, with a deactivated session.
- Destroyed

  The session no longer exists in memory. Here, the reference of the session object is null.

### Specifications & Validations

The HappyTree API performs a series of validations to avoid inconsistencies that violate the specifications. The validations occur in two situations: the first would be in the **API Transformation Process** and the other would be when invoking the methods of the **TreeManager** interface after the tree was built.

The HappyTree API can throw exceptions represented by two types of objects: TreeException and IllegalArgumentException.

The first one represents an exception class specific to the HappyTree API, and it is threw when an API specification is violated.

The last one is a runtime exception, native to Java. In the context of the HappyTree API, this exception is threw when the input variables are null.

| API Transformation Process (before the tree built) | | |
|---|---|---|
| **Specification** | **Message** | **Type** |
| The input parameters cannot be null. | Invalid null/empty argument(s). | IllegalArgumentException |
| The session identifier must be unique. | Already existing initialized session. | TreeException |
| The class of the object to be transformed must be annotated with **@Tree**. | There is no @TREE associated. | TreeException |
| The Id of the object to be transformed must be annotated with **@Id**. | There is no @ID associated. | TreeException |
| The parent Id of the object to be transformed must be annotated with **@Parent**. | There is no @PARENT associated. | TreeException |
| The class of the object to be transformed must have an empty constructor, getters, and setters. | Impossible to transform input object. Ensure the existence of getters and setters. | TreeException |
| The **@Id** attribute value cannot be null. | Invalid null/empty argument(s). | IllegalArgumentException |
| The value of the **@Id** attribute cannot be duplicated in relation to another object within the same tree session. | Duplicated ID. | TreeException |
| The @Id and @Parent attributes must be of the same type. | Mismatch type ID error. | TreeException |

| TreeManager Methods Operations (after the tree built) | | |
|---|---|---|
| **Specification** | **Message** | **Type** |
| The input parameters cannot be null. | Invalid null/empty argument(s). | IllegalArgumentException |
| When invoking an operation that handle directly elements in the tree, the transaction must reference a defined session. | No defined session. | TreeException |
| When invoking an operation that handle | No active session. | TreeException |

| | | |
|---|---|---|
| directly elements in the tree, the transaction must reference an active session. | | |
| When handling an element, make sure that the associated transaction references the correct session to which the element belongs. | Element not defined in this session. | TreeException |
| By copying or moving an element from one tree to another, both trees must have the same type of object that the ***Element*** wraps. | Mismatch type error. Incompatible parameterized type tree. | TreeException |
| It is not possible to perform operations on elements that represent the root of a tree. | No possible to handle the root of the tree. Consider using a transaction to clone trees. | TreeException |
| Operations that change the state of the tree can only be performed depending on the lifecycle of the elements involved in these operations (See the state diagram above, previous chapter). | • No possible to copy/cut/remove elements. Invalid lifecycle state;<br>• No possible to persist the element. Invalid lifecycle state;<br>• No possible to update the element. Invalid lifecycle state. | TreeException |
| Duplicate ID elements are not allowed within the same tree. | Duplicated ID. | TreeException |
| When a session is initialized, the root element **@Id** of the tree is the same as the identifier of the initialized session itself. | | |

### API Transformation Process (ATP)

As mentioned initially, this mechanism is responsible for transforming a linear structure of Java model

objects, which are originally related through a tree behavior, but which they are not structurally represented as one.

The definition of "having a tree behavior even though it is not" means having a collection of objects that logically relate their self, which one object is child of another one, but that structurally these objects are not contained within each other.

Therefore, this mechanism transforms this linear structure in such a way that objects are structurally placed inside another. In the end, a resulting object may have a list of children contained within it, where each child may have another list of children, and so on.

We saw that there are two ways to initialize a session, one of which is responsible for initializing a session by passing a collection of objects to be transformed, thus triggering the **API Transformation Process**. Let's review then.

*Creating a new tree from scratch*

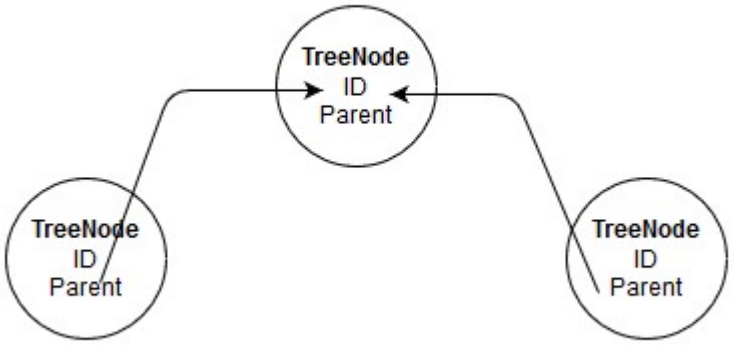
Here, there is no the **ATP**. The API client just initialize a standard new tree session for handling after. The result of this is a tree containing only the root element.

The version of the invoked method to initialize a standard tree session is *Transaction.initializeSession (String, Class)*, where ***String*** is the session identifier (unique and not ***null***) and ***Class*** is the parameterized type of the tree that will be used by

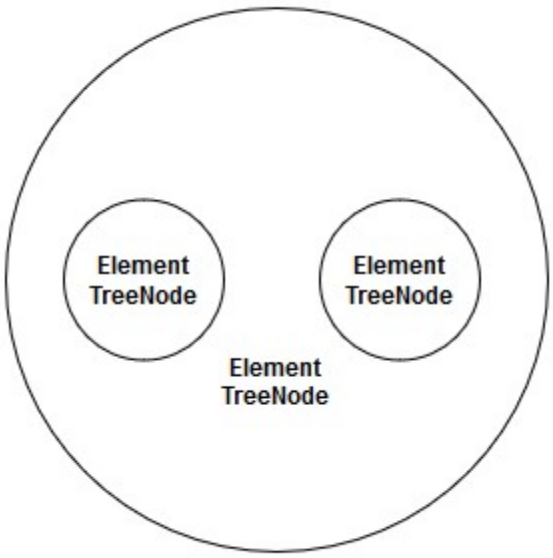
the ***Element*** interface to wrap an object that would represent a node in the tree.

*Creating a new tree using the ATP*

The API client has a structure that would represents a tree, but it is designed in a linear form like:

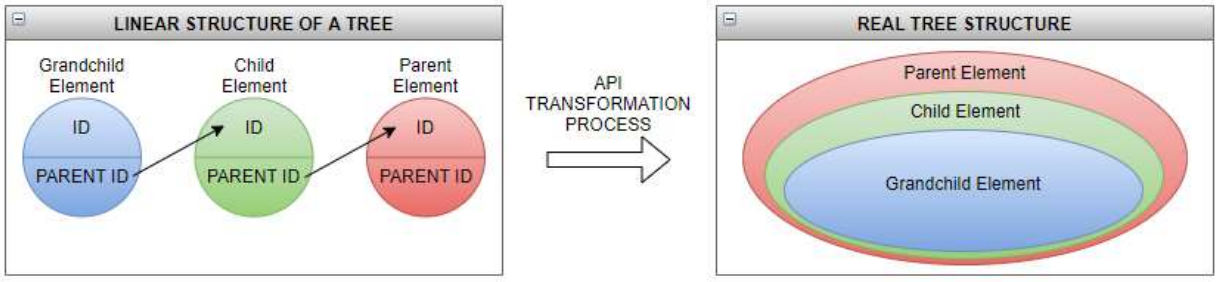



Then, this structure will be transformed into:



The version of the invoked method to initialize a tree session through **ATP** is *Transaction.initializeSession (String, Collection)* where ***String*** is the session identifier (unique and not ***null***) and ***Collection*** represents the list of object to be transformed by **ATP**.

This collection contains objects whose class is annotated by **@Tree**, **@Id** and **@Parent** and consequently represents the parameterized type of the tree. During the transformation process (**ATP lifecycle**), these objects will be automatically wrapped within their respective element in the current tree session, thus representing nodes in the tree. To unwrap the respective object from an element, simply invoke *Element.unwrap()*.



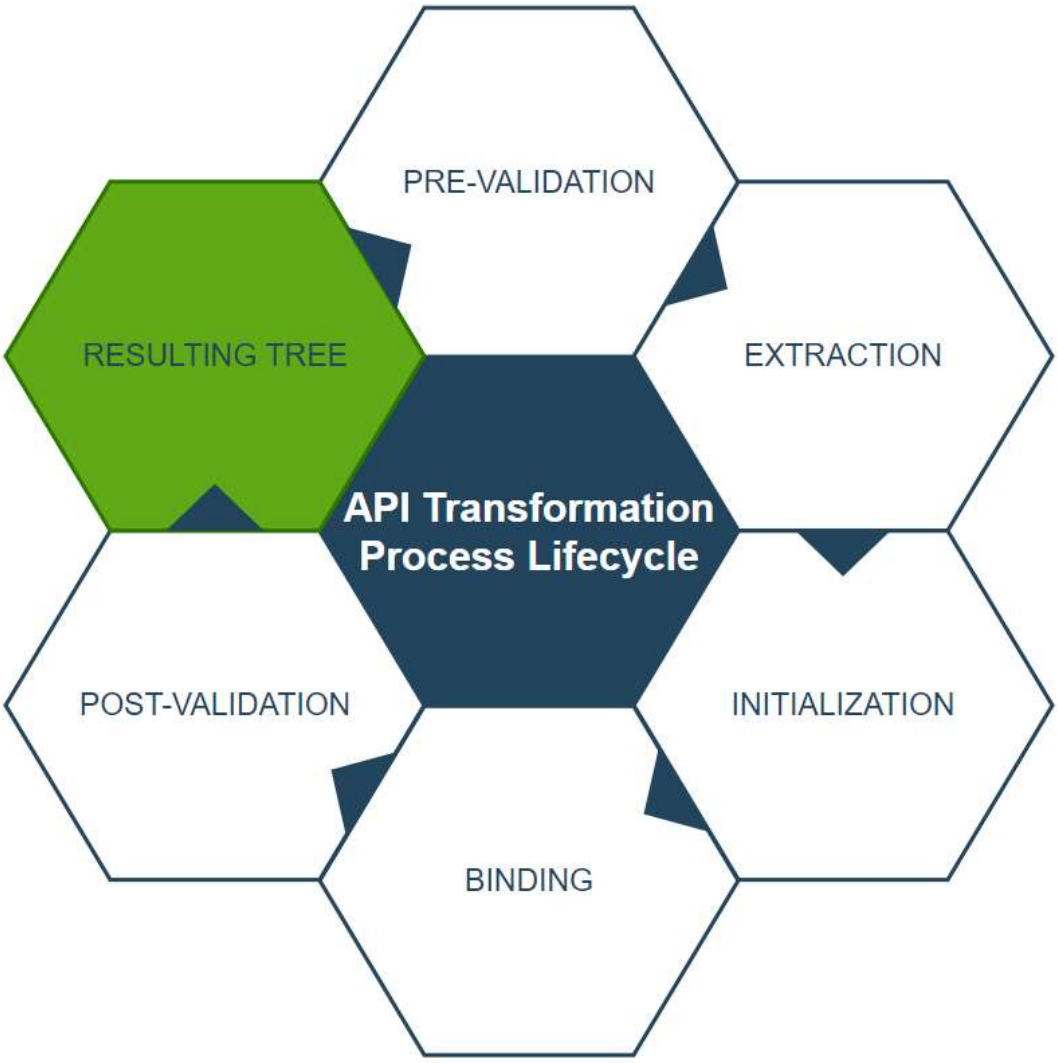

*ATP Lifecycle*

The **API Transformation Process** has an inner-implementation of a lifecycle, which basically consists of distinct phases that aim to transform the linear structure of objects, that would represent a tree data structure, into a real tree.

Its lifecycle has no impact at the functional level, when the API client makes use of it. The explanation contained here is purely informative, serving only for

users to better understand the process of assembling a tree from a legacy structure of linear objects of which they would represent a tree.

As input, ATP receives the list of objects that will be transformed into a tree through five distinct and consecutive phases:




1. Pre-Validation

   It performs validations in order to verify if the received input is compatible with the adopted specifications. It can throw

***IllegalArgumentException*** if the list of objects to be transformed is empty or *null* and ***TreeException*** in the other specifications.

The following validations are:

- Verifies that the list of objects to be transformed is not *null* or empty;
- Verifies whether there is an existing session with the same identifier;
- Verifies that the class of the objects to be transformed is annotated with **@Tree;**
- Verifies that the class of the objects to be transformed is annotated with **@Id;**
- Verifies that the class of the objects to be transformed is annotated with **@Parent;**
- Verifies that the **@Id** and **@Parent** attributes have the same type;
- Verifies whether there is an object with *null* **@Id** value;
- Checks for duplicate IDs;
- Verifies that the class of the objects to be transformed has getters & setters.

2. Extraction

If the input represented by the list of objects to be transformed passed all validations from the previous phase, then the HappyTree API takes them and extracts them in order to separate them from their respective parents. Therefore, as a product for the next phase,

there will be the objects and their respective parents separated into two blocks.

3. Initialization

In this phase, the HappyTree API instantiates an object of type ***Element*** for each source object used as input and passes the respective **@Id** and **@Parent** attributes of the source object to that element. In addition, the source object itself is automatically wrapped into that element, thus making the source object liable to be a tree node, since the element naturally represents a node in the context of the HappyTree API.
After the tree is built, to retrieve the source object just invoke the *Element.unwrap()* method.

As a product of this phase, we already have the instantiated elements with all the information from the source objects.

4. Binding

After obtaining the list of resulting elements from the previous phase, the HappyTree API will now bind each element to its respective parent, through the block of separated parent objects in the **Extraction** phase.

Therefore, it is at this phase that the tree is actually assembled. Thus, for each node in

the tree we have a represented element object, where each element has:

- The **@Id** attribute value;
- The **@parent** attribute value;
- The ***wrappedObject*** corresponding the respective source object transformed in this process;
- The collection of ***children***, corresponding to other elements in which they are children of this;
- The tree ***session***, which this element belongs.

5.Post-Validation

This phase confirms that the provided input corresponds exactly to the generated output (the tree itself). If there is any inconsistency, a **TreeException** is threw, immediately aborting the process and rolling back the session.