“Code Scent”, Customizable Code Smell Detection Plugin for IntelliJ IDEA

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1. Description of Our Project

1.1 Goal

The primary goal of "Code Scent" is to enhance code quality in software development projects by detecting and addressing code smells within the developer's workspace. It aims to assist in maintaining clean, readable, and well-organized code, which is essential for the scalability, maintainability, and performance of software.

Our plugin offers customization options, allowing users to set their own parameters for detecting various code smells, making it adaptable to different coding styles and preferences.

1.2 Problem and Solution

The problem addressed by "Code Scent" is the presence of "code smells" in software development projects. These are suboptimal coding patterns that, while not stopping the code from functioning, make it harder to understand, maintain, and modify. Such issues can lead to difficulties in bug fixing, feature addition, and general code alteration, potentially resulting in new bugs.

"Code Scent" offers an innovative solution by introducing an automated, intelligent code smell detection system within the IntelliJ IDEA environment. This is further enhanced by its unique customization feature, which allows users to customize the detection parameters to their specific needs and preferences.

This level of customization ensures that developers can optimize the tool to better align with their individual coding styles and project requirements, thereby maximizing the advantage and utility of "Code Scent" in various software development scenarios.

2. Architecture and Design

2.1 Major Components of Our Implementation

For our project “Code Scent”, major implementations are divided into different components as `detecting`, `ui`, `utils`, and `test`. `detecting` component includes classes for detecting code smells.`ui` component includes classes for GUI configurations and is further grouped into `analyzing`, and `customizing` parts. `utils` component includes a `LoadPsi` class that is commonly used in `detecting` classes. `test` component includes classes for testing our `detecting` package.

More detailed description of our major components will be provided later in the next following sections.

2.2 Code Smell Detection Functionality Model

2.2.1 Model of `Detecting` and `utils` Package

The `BaseDetectAction.java` file is an abstract class belonging to `detecting` package. It's designed to provide a framework for code smell detection techniques.

The class is abstract, so it's intended to be subclassed by other specific detection classes. It defines abstract methods like `storyID(),description()`, which would be implemented by subclasses to provide specific functionality for different types of code smells. `BaseDetectAction` serves as a base class for other code smell detection classes, such as those for detecting comments, dead code, duplicated code, etc. Each specific detection class would extend this base class and implement its abstract methods.

Each of these subclasses (`Comments`, `DeadCode`, `DuplicatedCode`) extends the `BaseDetectAction` class. This inheritance would allow them to utilize the common framework provided by `BaseDetectAction` for code smell detection, while implementing specific strategies for their respective focused areas.

`BaseDetectAction` (Abstract Class):

- Central class in the diagram. It is an abstract class with abstract methods (like `storyID(), storyName()`) that need to be implemented by its subclasses.
- The class is part of the `detecting` package due to its role in detecting various code smells.

Code smell detecting classes (subclasses of `BaseDetectAction`):

Each of the following subclasses extend the `BaseDetectAction` class, thus they have inheritance relationship. They are also part of the `detecting` package.

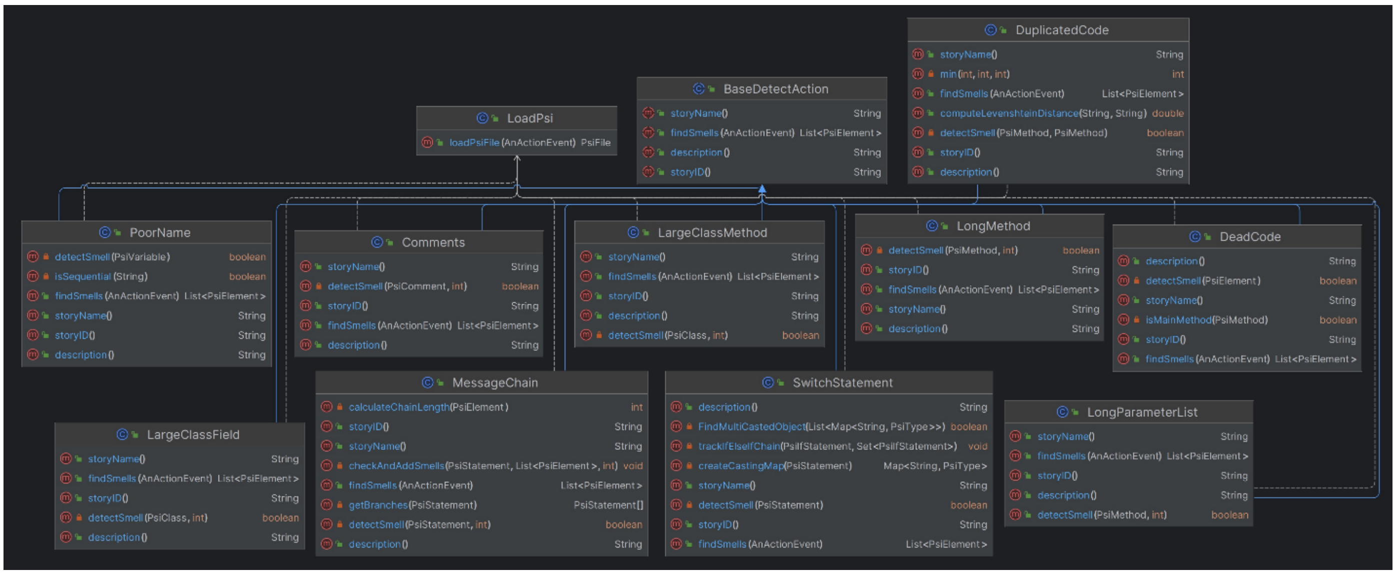
1. `Comments`: Implements specific methods for detecting comments code smells
2. `DeadCode`: Focuses on identifying unused code.
3. `LargeClassMethod`: Deals with the "Large Class" code smell, where a class does too many methods.
4. `LongMethod`: This would handle the "Long Method" smell, identifying methods that are too long
5. `PoorName`: Deals with naming conventions and identifies variables, methods, or classes that are poorly named and therefore could make the code harder to understand and maintain.
6. `LargeClassField`: Similar to `LargeClassMethod`, but focused on classes that may have too many fields (properties), suggesting that it may be violating the single responsibility principle by holding too much state.
7. `LongParameterList`: Looks for methods that have too many parameters, which can make methods difficult to understand and maintain.
8. `MessageChain`: Concerned with the "Message Chain" code smell, which occurs when a client requests a chain of method calls to navigate through multiple objects.

9. SwitchStatement: Deals with the "Switch Statement" smell. Excessive use of switch statements can be a sign that polymorphism could be utilized instead.
10. DuplicatedCode: Concerned with the "Duplicated Code" code smell, which occurs when a similar implementation of methods are used. The similarity is measured using Levenshtein distance.

Utils LoadPsi (Dependency relationship with code smell detecting classes):

The LoadPsi.java file contains a single public static method loadPsiFile which is designed to retrieve a PsiFile instance from the IntelliJ IDEA IDE environment when an action is performed. This class is used for all code smell detecting classes, thus they have dependency relationship.

UML class diagram for these relationships are shown below. All subclasses are inheritance of BaseDetectAction, and all of them also have dependency relationship with LoadPsi.



LoadPsi
loadPsiFile(AnActionEvent) PsiFile
BaseDetectAction
storyName() String
findSmells(AnActionEvent) List<PsiElement>
description() String
storyID() String
DuplicatedCode
storyName() String
min(int, int, int) int
findSmells(AnActionEvent) List<PsiElement>
computeLevenshteinDistance(String, String) double
detectSmell(PsiMethod, PsiMethod) boolean
storyID() String
description() String
PoorName
detectSmell(PsiVariable) boolean
isSequential(String) boolean
findSmells(AnActionEvent) List<PsiElement>
storyName() String
storyID() String
description() String
Comments
storyName() String
detectSmell(PsiComment, int) boolean
storyID() String
findSmells(AnActionEvent) List<PsiElement>
description() String
LargeClassMethod
storyName() String
findSmells(AnActionEvent) List<PsiElement>
storyID() String
description() String
detectSmell(PsiClass, int) boolean
LongMethod
detectSmell(PsiMethod, int) boolean
storyID() String
findSmells(AnActionEvent) List<PsiElement>
storyName() String
description() String
DeadCode
description() String
detectSmell(PsiElement) boolean
storyName() String
isMainMethod(PsiMethod) boolean
storyID() String
findSmells(AnActionEvent) List<PsiElement>
LargeClassField
storyName() String
findSmells(AnActionEvent) List<PsiElement>
storyID() String
detectSmell(PsiClass, int) boolean
description() String
MessageChain
calculateChainLength(PsiElement) int
storyID() String
storyName() String
checkAndAddSmells(PsiStatement, List<PsiElement>, int) void
findSmells(AnActionEvent) List<PsiElement>
getBranches(PsiStatement) PsiStatement[]
detectSmell(PsiStatement, int) boolean
description() String
SwitchStatement
description() String
FindMultiCastedObject(List<Map<String, PsiType>>) boolean
trackIfElseIfChain(PsiIfStatement, Set<PsiIfStatement>) void
createCastingMap(PsiStatement) Map<String, PsiType>
storyName() String
detectSmell(PsiStatement) boolean
storyID() String
findSmells(AnActionEvent) List<PsiElement>
LongParameterList
storyName() String
findSmells(AnActionEvent) List<PsiElement>
storyID() String
description() String
detectSmell(PsiMethod, int) boolean

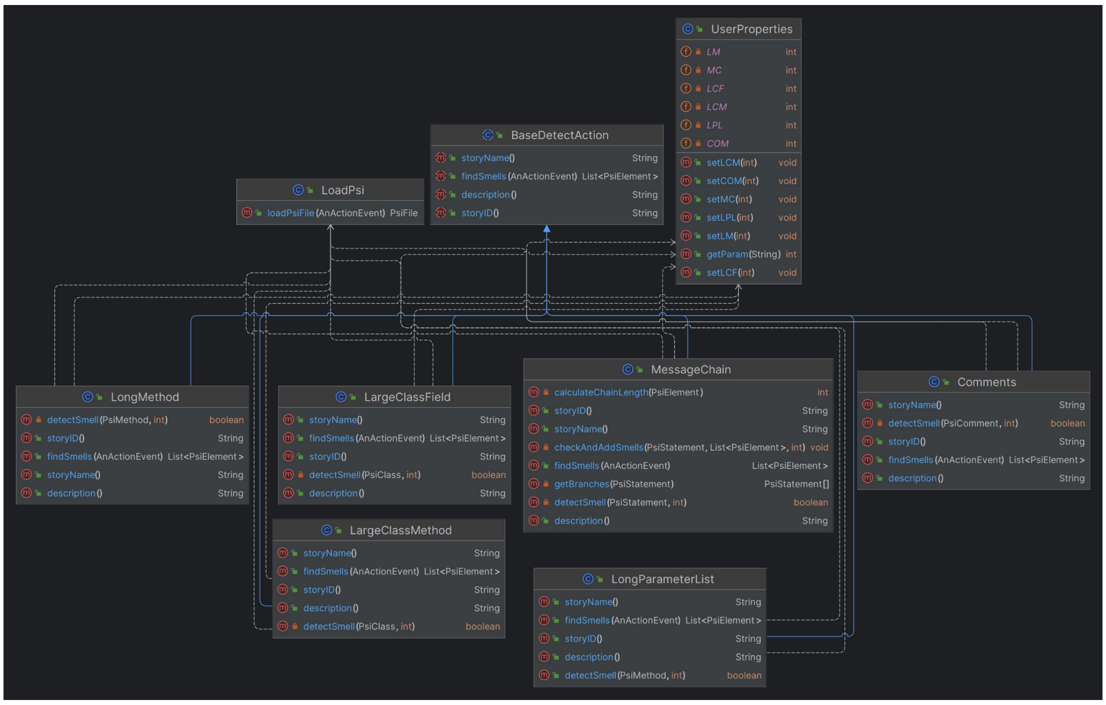
2.2.2 Model of Detecting and UserProperties Package

UserProperties class represents a pattern for managing configuration settings in an application, encapsulating the settings in static variables and providing a standardized way to access and modify them, with persistence handled by another class HandleConfig.

For example in the LongMethod class, which extends BaseDetectAction, UserProperties class is used to get a user-defined threshold for what constitutes a "long method." This is done by the getParam method of the UserProperties class. The findSmells method calls UserProperties.getParam(storyID()) to get the user-defined maximum line count for a method to be considered long. The storyID() method returns the string "LM", which corresponds to the "Long Method" threshold in the UserProperties class.

UML class diagram for relationships between user customizable code smell detection classes and UserProperties are shown below. All of the code smell detection classes have dependency relationships with UserProperties and LoadPsi.

More details about UserProperties are given in **2.3.2 Model of ui.customizing package.**


UserProperties
LM int
MC int
LCF int
LCM int
LPL int
COM int
setLCM(int) void
setCOM(int) void
setMC(int) void
setLPL(int) void
setLM(int) void
getParam(String) int
setLCF(int) void
BaseDetectAction
storyName() String
findSmells(AnActionEvent) List<PsiElement>
description() String
storyID() String
LoadPsi
loadPsiFile(AnActionEvent) PsiFile
LongMethod
detectSmell(PsiMethod, int) boolean
storyID() String
findSmells(AnActionEvent) List<PsiElement>
storyName() String
description() String
LargeClassField
storyName() String
findSmells(AnActionEvent) List<PsiElement>
storyID() String
detectSmell(PsiClass, int) boolean
description() String
LargeClassMethod
storyName() String
findSmells(AnActionEvent) List<PsiElement>
storyID() String
description() String
detectSmell(PsiClass, int) boolean
MessageChain
calculateChainLength(PsiElement) int
storyID() String
storyName() String
checkAndAddSmells(PsiStatement, List<PsiElement>, int) void
findSmells(AnActionEvent) List<PsiElement>
getBranches(PsiStatement) PsiStatement[]
detectSmell(PsiStatement, int) boolean
description() String
Comments
storyName() String
detectSmell(PsiComment, int) boolean
storyID() String
findSmells(AnActionEvent) List<PsiElement>
description() String
LongParameterList
storyName() String
findSmells(AnActionEvent) List<PsiElement>
storyID() String
description() String
detectSmell(PsiMethod, int) boolean

2.3 GUI Model

2.3.1 Model of ui.analyzing package

ui.analyze package is related to displaying code smell results. This package shows a tool window to users, enabling them to identify the results.

The MyToolWindowAction.java class in the ui package extends AnAction class user's actions with the GUI. This class is connected with plugin.xml to respond to the user's action.

MyToolWindowAction:

- **actionPerformed Method**: A public method that activates a specific tool window named "Code Scent" within a project, if the window is available, when an action event occurs.

The MyToolWindowFactory.java class in the ui package extends the ToolWindowFactory class to create and configure a specific tool window within the user interface.

MyToolWindowFactory:

- **Static Variables:** The class defines the following static variables.
  - customizeButton: JButton object for 'Customize' button.
  - analyzeButton: JButton object for 'Analyze' button.
  - analyzeallButton: JButton object for 'Analyze all' button.
  - buttonPanel: Jpanel object contains 'Customize', 'Analyze' and 'Analyze all' buttons.
  - treeWindow: JBScrollPane object for tree.
  - mainPanel: JPanel object, which is the main container for other UI components in the class.

    - project: `Project` object of current project context.
    - tree: `JTree` object, which is used to display a hierarchical structure of data.
    - resultAll: This field serves as a storage for results, mapping strings to lists of PsiElement objects.
- **`getActiveProject` Method:** A private method that iterates through open projects to find and return the active one. If no active project is found, it returns the first open project as a fallback.
- **`createToolWindowContent` Method:** A public method that sets up the content for a tool window within a given project. It initializes UI components like panels, buttons, and a scroll pane, and arranges them in the mainPanel. The method also defines actions for buttons and adds the fully assembled mainPanel to the tool window's content manager. This setup is essential for creating the interactive part of the tool window.
- **`updateUIWithAnalyzeResult` Method:** A public method that updates the UI to display analysis results. It removes the old tree view, fetches the active project, creates a new `TreeStructureWindow` class with the current results, and then adds this updated tree view to the mainPanel.
- **`updateUIWithAnalyzeAllResult` Method:** A public method that updates the UI based on analysis results. It merges the new results with the existing resultAll, refreshes the treeWindow with a new `TreeStructureWindow` class reflecting the updated data, and repositions it in the mainPanel. This method ensures the UI reflects the most current analysis state.
- **`customDataContext` Method:** A public method that creates a custom `DataContext`. It processes a `VirtualFile` object, manages file editors, and retrieves the `Editor` and `PsiFile` associated with the file. The method creates and returns a new `DataContext` instance, providing data relevant to the current file, editor, and PSI file, alongside other existing data from the original context.
- **`mergeMaps` Method:** A public method to merge two `Map<String, List<PsiElement>>` objects. It combines the lists associated with each key, adding entries from the first map to the second.
- **`listFilesForFolder` Method:** A public method to recursively gather `VirtualFile` objects representing Java source files from a specified folder and its subdirectories, focusing on files within the "main\\java" path.

The `AnalyzeAction.java` class in the `ui.analyze` package extends `AnAction` class to connect user's actions with the GUI. This class is connected with `plugin.xml` to respond to the user's action.

`AnalyzeAction`:

- **`setResultListener` Method:** A public method to set an `AnalyzeResultListener` instance to the `resultListener` field, enabling customized event handling.
- **`actionPerformed` Method:** A public method overrides a specific event handling method. It initializes necessary resources, processes a predefined list of `storyID` to detect code smells, and accumulates the results. If a result listener is set, the method triggers it with the compiled results.

The `AnalyzeResultListener.java` class in the ui.analyze package is an `interface` class that stores analysis results from `AnalyzeAction.java` and returns the results to `MyToolWindowFactory.java`.

`AnalyzeResultListener`:

- **`onAnalyzeResult` Method:** A method in an interface, requiring implementation to handle analysis results, provided as a `Map<String, List<PsiElement>>`. It processes the results, typically representing code smells or similar findings, each mapped to a string key.

The `BaseDetectManager.java` class in the `ui.analyze` package handles `storyID`, which are defined at each Code Smell Detection. This class is connected to `AnalyzeAction.java` and `ProjectTreeModelFactory.java` to fetch `BaseDetectAction` method names by `storyID`.

`BaseDetectManager`:

- **Static Variable:** The class defines the following static variable.
  - manager: A variable storing the singleton instance of the `BaseDetectManager` class.
- **Constructor:** A protected constructor of the `BaseDetectManager` class, used to prevent external instantiation and support the singleton pattern.
- **`getDetectActionByID` Method:** A public method in the `BaseDetectManager` class that returns a `BaseDetectAction` object based on the provided id. It utilizes a switch statement to select and instantiate specific types of detect actions. If the id does not match any case, the method returns null.

The `CodescentPopUp.java` class in the `ui.analyze` package extends `JPopupMenu` class to create a context-specific popup menu. It specializes in displaying information related to `BaseDetectAction` objects.

`CodescentPopUp`:

- **Constructor:** A public constructor that adds a menu item with the description of a `BaseDetectAction` object to the popup, if the provided object is an instance of `BaseDetectAction`.

The `TreeStructureWindow.java` class in the `ui.analyze` package extends `Tree` class that is connected with `MyToolWindowFactory` class to show tree structure of result analyzing code smell.

`TreeStructureWindow`:

- **Static Variables:** The class defines the following static variables.
  - Icon1: An icon loaded from `/general/projectStructure.svg`
  - Icon2: An icon loaded from `/nodes/configFolder.svg`
  - Icon3: An icon loaded from `/nodes/editorconfig.svg`
  - currentHighlighter: `RangeHighlighter` object, which is used for managing text highlighting in the UI.

- **Constructor:** In Constructor It gets a model to set a `Tree`, and set a cell render to display the name and icon of each node, and set a mouse listener to handle click events.

1. **Getting a tree model**
   by `setModel` **Method**, it gets tree model from `createProjectTreeModel` in the `ProjectTreeModelFactory` class.

2. **Setting a cell renderer**
   For each node, the renderer assigns different icons according to feature of each node - icon 1 for `project` node, icon 2 for the `BaseDetectAction` object node, icon 3 for `PsiElement` object node. And for the `PsiElement` object node, it appends `fileName`, `lineNumber`, and if possible name of `PsiElement` information of each `PsiElement` that the user can easily check where and which part of the code code smell occurs.

3. **Setting a mouse listener**

   a) one mouse click
   When the mouse click once it gets the clicked object of the node. Then it gets `TextAttributes` and offset of the element to make background color of the code smell element Yellow. Using `MarkupModel` class and `currentHighlighter` that is an instance of `RangeHighlighter` class, it removes the current highlighter in the scrollbar and add new highlighter according to the offset of the element with color pink. Also With the method of `RangeHighlighter` class the comment “code smell detected” is shown when the mouse hovered on the pink colored scrollbar stripe mark.

   b) double mouse click
   When mouse double click it gets the clicked object of the node.When the object is an instance of `PsiElement` it gets the `OpenFileDescriptor` object that element belongs to by `getTextOffset` method and `getContainingFile` method of object. Then, it navigates to the descriptor to move to the location of the element.

   c) mouse right click
   When mouse right click it gets the clicked object of the node.to show popup that shows description of clicked code smell, it create `CodescentPopUp` class object for the code smell type.

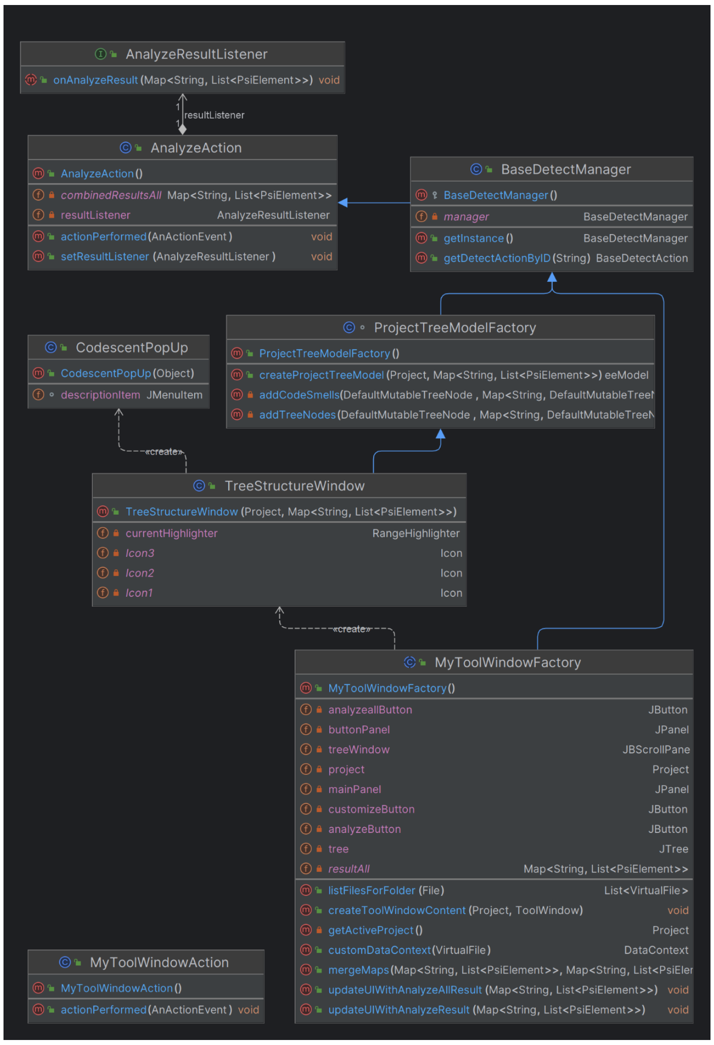
The `ProjectTreeModelFactory` class is statically used by `TreeStructureWindow.java`. Instance of `ProjectTreeModelFactory` class is not used but the method is just used to make a `TreeModel` object of result from `AnalyzeAction` class.

`ProjectTreeModelFactory`

- **`createProjectTreeModel` Method:** This method builds treemodel and returns it based on the active `project` and `result` provided as a `Map<String, List<PsiElement>>` from `AnalyzeAction`. At first the root node corresponding to the active `project` is created. Then for each `List<PsiElement>` of the code smell from `result`, corresponding nodes are added as children under codesmell type nodes by **`addTreeNodes`** method.
- **`addTreeNodes` Method:** This method is called by **`createProjectTreeModel`** method to add node for each `psiElement` in `psiElements` provided as `List<PsiElement>`. If node for code smell type already exists, node is just added under the node. If not, a node for code smell type is added under root node calling **`addCodeSmells`** method.
- **`addCodeSmells` Method:** This method is for adding node for the code smell type under the root node. Since this method make node based on `BaseDetectAction` object of code smell type, `BaseDetectManager` is used to get `BaseDetectAction` object.

UML class diagram for these relationships are shown below. You can see in the UML class diagram that **`MyToolWindowFactory`** class have reference to **`AnalyzeAction`** class and **`TreeStructureWindow`** class to detect code smells in the file and to show `Tree` object that show the result of detecting in the window. **`AnalyzeAction`** class have reference to **`BaseDetectManager`** to get every **`BaseDetectAction`** class object to check for every each code smell type. Also **`AnalyzeAction`** class is connected with **`AnalyzeResultListener`** in **`MyToolWindowFactory`** class since it can get the result of detecting dynamically.

On the other hand, **`TreeStructureWindow`** class has reference to both **`ProjectTreeModelFactory`** class and **`CodescentPopUp`** class to get **`TreeModel`** object and to show popup when the codescent type node in the tree is right clicked reference. **`ProjectTreeModelFactory`** class have reference to **`BaseDetectManager`** class to get **`BaseDetectAction`** class object when adding node for each code smell type.


AnalyzeResultListener
onAnalyzeResult(Map<String, List<PsiElement>>) void
resultListener
AnalyzeAction
AnalyzeAction()
combinedResultsAll Map<String, List<PsiElement>>
resultListener AnalyzeResultListener
actionPerformed(AnActionEvent) void
setResultListener(AnalyzeResultListener) void
BaseDetectManager
BaseDetectManager()
manager BaseDetectManager
getInstance() BaseDetectManager
getDetectActionByID(String) BaseDetectAction
CodescentPopUp
CodescentPopUp(Object)
descriptionItem JMenuItem
ProjectTreeModelFactory
ProjectTreeModelFactory()
createProjectTreeModel(Project, Map<String, List<PsiElement>>) eeModel
addCodeSmells(DefaultMutableTreeNode, Map<String, DefaultMutableTree
addTreeNodes(DefaultMutableTreeNode, Map<String, DefaultMutableTree
«create»
TreeStructureWindow
TreeStructureWindow(Project, Map<String, List<PsiElement>>)
currentHighlighter RangeHighlighter
Icon3 Icon
Icon2 Icon
Icon1 Icon
«create»
MyToolWindowFactory
MyToolWindowFactory()
analyzeallButton JButton
buttonPanel JPanel
treeWindow JBScrollPane
project Project
mainPanel JPanel
customizeButton JButton
analyzeButton JButton
tree JTree
resultAll Map<String, List<PsiElement>>
listFilesForFolder(File) List<VirtualFile>
createToolWindowContent(Project, ToolWindow) void
getActiveProject() Project
customDataContext(VirtualFile) DataContext
mergeMaps(Map<String, List<PsiElement>>, Map<String, List<PsiEler
updateUIWithAnalyzeAllResult(Map<String, List<PsiElement>>) void
updateUIWithAnalyzeResult(Map<String, List<PsiElement>>) void
MyToolWindowAction
MyToolWindowAction()
actionPerformed(AnActionEvent) void

2.3.2 Model of `ui.customizing` package

`ui.customizing` package is related to the user's parameter customization. This package shows pop-up to users and enables them to customize thresholds used in code smell detection.

The `HandleConfig.java` class in the `ui.customizing` package handles `codescent.properties` file, which is located right below the root of the project.

`HandleConfig`:

- **Static Variables:** The class defines following static integer variables.
  - configPath: A path of `codescent.properties` file.
  - configFile: `File` object of config file.
  - prop: `Properties` object of config file.
  - fis: `FileInputStream` object used when user changes parameter.
  - handler: `HandleConfig` object, which is implemented as a singleton design pattern.
- **initializeConfig Method:** Designed to check whether config file exists and initialize parameters in `Userproperties` class. If there is no config file, call the `createConfig` method to create a new config file. After creating a file or file exists, parses parameters from the config file and sets parameters in `UserProperties` class.

- **getHandler Method:** Designed to make class as a singleton design pattern. If there is no `handler` variable created, call the constructor of the class to create a variable. Returns the `handler` variable of `HandleConfig` class.
- **getConfigParam Method:** Takes `String` parameter `storyID`. Loads parameter of `storyID` and returns it.
- **setConfigParam Method:** Takes `String` parameter `storyID` and `int` parameter `param`. Set `storyID`'s parameter into `param` write to config file.
- **createConfig method:** Creates `codescent.properties` file with `configFile` into `configPath`. The file is set with default parameters.

The `UserProperties.java` class in the `ui.customizing` package is a **utility** class that stores and manages user-customized properties related to the thresholds for various code smell condition parameters. Each of these parameters represents a customizable setting that a user of the system can modify, presumably to alter the behavior code smell detection functions.

`UserProperties`:

- **Static Variables:** The class defines the following static integer variables.
  - LM: Threshold for determining if a method is considered long.
  - LCF: Threshold for the number of fields in a class.
  - LCM: Threshold for the number of methods in a class.
  - LPL: Threshold for the number of parameters in a method's signature.
  - MC:Threshold for the length of a message chain.
  - COM: Threshold for length of comments in the code.
- **getParam Method:** This method takes a `String` parameter `storyID`, which is expected to match one of the predefined keys corresponding to the static variables.
- **initializeParam Method:** Designed to initialize the parameters from configuration source. It calls `HandleConfig.initializeConfig()`, which reads configuration file to set up initial values.
- **Setter Methods:** There are setter methods for each of the static variables (setLM, setLCM, setLCF, setLPL, setMC, setCOM). Each method updates the corresponding static variable with the new value entered by the user as a parameter and then calls a method in `HandleConfig` to persist this new value in the configuration `setConfigParam`.

The `CustomizeAction.java` class in the `ui.customizing` package extends `AnAction` class to connect user's actions with customization GUI. This class is connected with `plugin.xml` to respond to the user's action.

`CustomizeAction`:

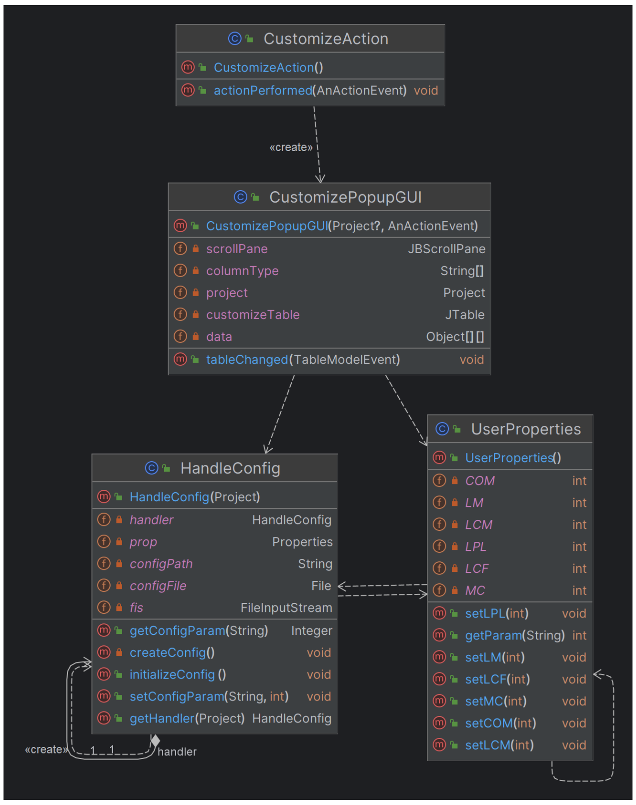
- **actionPerformed Method:** This method overrides `AnAction` class's same method. This method takes `AnActionEvent e`. We can get `Project` class object from `AnActionEvent`, and give as parameter when create new `CustomizePopipGUI` object to show pop-up window.

The `CustomizePopupGUI.java` class in the `ui.customizing` package is a **GUI** class that shows a user customizable pop-up window. This class extends `JFrame` class and implements `TableModelListener` class.

`CustomizePopupGUI`:

- **Variables:** The class defines the following static integer variables.
  - customizeTable: A table that the user can change its contents.
  - scrollPane: An object that actually shows `customizeTable` visually.
  - columnType: Two column types, which are parameter and input.
  - data: Actual data which is shown at pop-up.
  - project: `Project` object, which represents this project.
- **Constructor:** The constructor initializes the table which is shown at pop-up. First, constructor initializes the `UserProperties` class's parameters to include in the table. After initializing parameters, create `data` and set other settings related to the pop-up window. The important part is making only the parameter column editable. After setting, we call `setVisible(true)` to make the pop-up table visible.
- **tableChanged Method:** This method overrides `TableModelListener` class's same method. In this method, we parse the user's input and check whether input is valid(positive integer form). If input is not valid, we show a warning message. If the input is valid, we apply the input into `UserProperties` class's parameter.

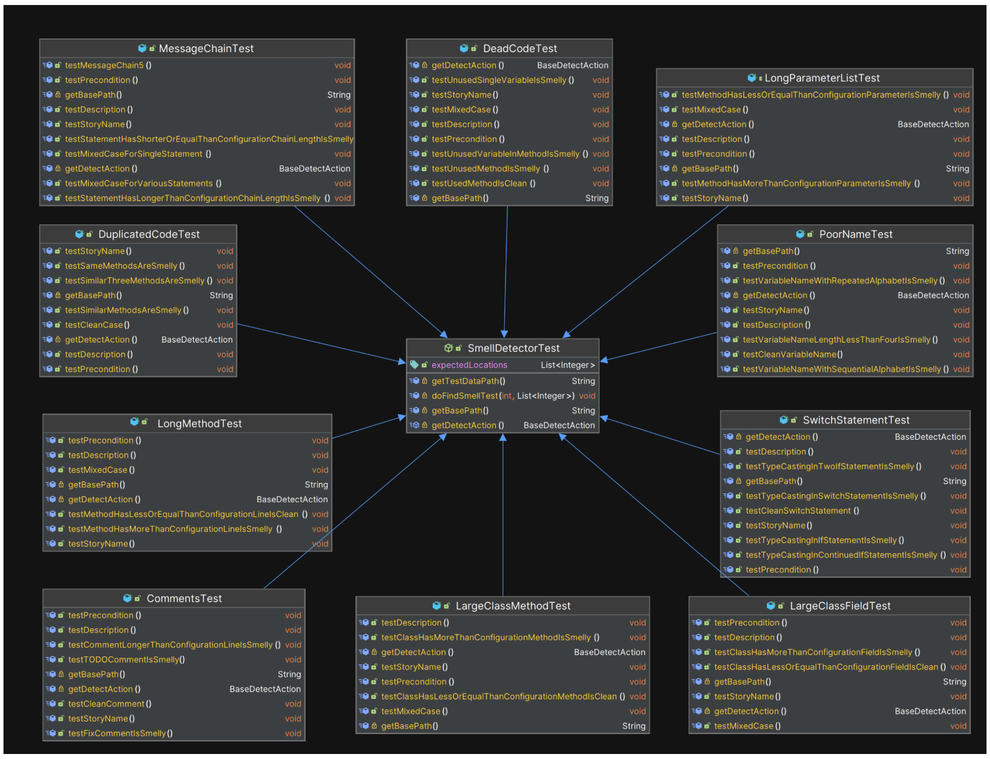
UML class diagram for these relationships are shown below. `CustomizeAction` creates `CustomizePopupGUI` class object. `HandleConfig` and `UserProperties` class have dependency relationship with `CustomizePopupGUI` and each other. `HandleConfig` class has a singleton design pattern.



2.4 Test Model

2.4.1 Model of `test` package

There are `java` and `test` packages in `test` package. The `java` package has `SmellDetectorTest` that is an abstract class for testing, and extended test classes for testing functionality in `detecting` package. UML class diagram for relationships of classes in `Test` package are shown below.


MessageChainTest
testMessageChain5 () void
testPrecondition () void
getBasePath() String
testDescription () void
testStoryName() void
testStatementHasShorterOrEqualThanConfigurationChainLengthIsSmelly
testMixedCaseForSingleStatement () void
getDetectAction () BaseDetectAction
testMixedCaseForVariousStatements () void
testStatementHasLongerThanConfigurationChainLengthIsSmelly () void
DeadCodeTest
getDetectAction () BaseDetectAction
testUnusedSingleVariableIsSmelly () void
testStoryName() void
testMixedCase () void
testDescription () void
testPrecondition () void
testUnusedVariableInMethodIsSmelly () void
testUnusedMethodIsSmelly () void
testUsedMethodIsClean () void
getBasePath() String
LongParameterListTest
testMethodHasLessOrEqualThanConfigurationParameterIsSmelly () void
testMixedCase () void
getDetectAction () BaseDetectAction
testDescription () void
testPrecondition () void
getBasePath() String
testMethodHasMoreThanConfigurationParameterIsSmelly () void
testStoryName() void
DuplicatedCodeTest
testStoryName() void
testSameMethodsAreSmelly () void
testSimilarThreeMethodsAreSmelly () void
getBasePath() String
testSimilarMethodsAreSmelly () void
testCleanCase() void
getDetectAction () BaseDetectAction
testDescription () void
testPrecondition () void
PoorNameTest
getBasePath() String
testPrecondition () void
testVariableNameWithRepeatedAlphabetIsSmelly () void
getDetectAction () BaseDetectAction
testStoryName() void
testDescription () void
testVariableNameLengthLessThanFourIsSmelly () void
testCleanVariableName() void
testVariableNameWithSequentialAlphabetIsSmelly () void
SmellDetectorTest
expectedLocations List<Integer>
getTestDataPath() String
doFindSmellTest(int, List<Integer>) void
getBasePath() String
getDetectAction () BaseDetectAction
LongMethodTest
testPrecondition () void
testDescription () void
testMixedCase () void
getBasePath() String
getDetectAction () BaseDetectAction
testMethodHasLessOrEqualThanConfigurationLineIsClean () void
testMethodHasMoreThanConfigurationLineIsSmelly () void
testStoryName() void
SwitchStatementTest
getDetectAction () BaseDetectAction
testDescription () void
testTypeCastingInTwoIfStatementIsSmelly () void
getBasePath() String
testTypeCastingInSwitchStatementIsSmelly () void
testCleanSwitchStatement () void
testStoryName() void
testTypeCastingInIfStatementIsSmelly () void
testTypeCastingInContinuedIfStatementIsSmelly () void
testPrecondition () void
CommentsTest
testPrecondition () void
testDescription () void
testCommentLongerThanConfigurationLineIsSmelly () void
testTODOCommentIsSmelly() void
getBasePath() String
getDetectAction () BaseDetectAction
testCleanComment () void
testStoryName() void
testFixCommentIsSmelly() void
LargeClassMethodTest
testDescription () void
testClassHasMoreThanConfigurationMethodIsSmelly () void
getDetectAction () BaseDetectAction
testStoryName() void
testPrecondition () void
testClassHasLessOrEqualThanConfigurationMethodIsClean () void
testMixedCase () void
getBasePath() String
LargeClassFieldTest
testPrecondition () void
testDescription () void
testClassHasMoreThanConfigurationFieldIsSmelly () void
testClassHasLessOrEqualThanConfigurationFieldIsClean () void
getBasePath() String
testStoryName() void
getDetectAction () BaseDetectAction
testMixedCase () void

2.4.2 `SmellDetectorTest` class: The core class for testing

We inherited the `LightJavaCodeInsightFixtureTestCase` class to build a test environment. This structure is Inspired by the *2020 wanted team's test structure*. The `LightJavaCodeInsightFixtureTestCase` class is a class that provides a test environment for the development of the IntelliJ plug-in. By inheriting this class, the `SmellDetectorTest` class acquires the ability to perform light code insights fixture tests in the IntelliJ environment. The part in our code that the class was used is as follows:

- Load test data files: When inherited, the `getTestDataPath`, `getBasePath`, and `configureByFiles` methods make it easy to locate test data files.
- Use `myFixture Object`: You can use the `myFixture object` to get insights on code modification and analysis during code testing. `myFixture.doSomething()`
- Utilize the IntelliJ API: The IntelliJ IDEA API enables you to perform a variety of functions. You can create AnActionEvent and use Data Manager and Action Manager to set the required context.

2.4.3 Fields and methods in the `SmellDetectorTest` class

1. **`expectedLocations`**: A variable of the type `List<Integer>` that stores the expected location of the detected smelly codes. Use this variable in the `doFindSmellTest` method to compare with the actual results.

2. **`getTestDataPath`**: A method that specifies the directory path where the test data file is located. The test data files used in the test case are loaded based on this path.

3. **`getBasePath`** method: A method that specifies the default path for test data files. The test data files are stored relative to this path.

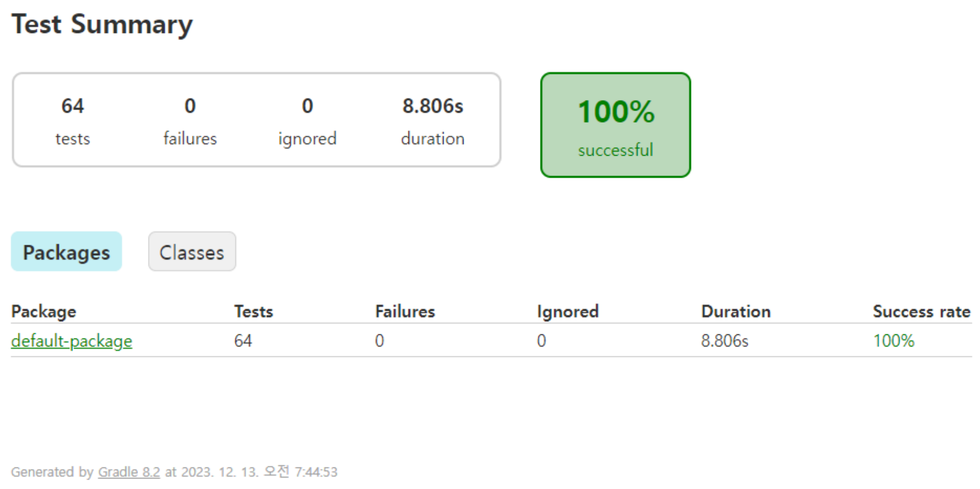
4. **`getDetectAction`**: An Abstract method that returns a `BaseDetectAction` object. This method must be implemented in a specific subclass.

5. **`doFindSmellTest`**: A method to detect smelly codes and verify results for a given test case number and a list of expected locations. Load a specific test data file using the `configureByFiles` method, and set AnActionEvent to create the required context. Call the findSmells method in `BaseDetectAction` to detect smelly codes and receive the results as a list of PsiElements. Calculate the location of the detected smelly codes and perform the test against the expected location list. This class provides a general test capability that sets up the test environment for the plug-in, detects smelly codes from specific test data files, and compares the detected location to the expected location.

3. Appendix

3.1 How to run automated tests

To run automated tests, type `./gradlew test` command in terminal.
you can get below test report in *`csed332project/build/reports/tests/test`*



Test Summary

64	0	0	8.806s	100%
tests	failures	ignored	duration	successful

Packages | Classes

Package	Tests	Failures	Ignored	Duration	Success rate
default-package	64	0	0	8.806s	100%

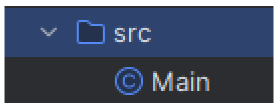
Generated by Gradle 8.2 at 2023. 12. 13. 오전 7:44:53

To test manually with GUI, follow below steps.

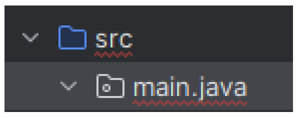
3.2 Ready to get into CodeScent

1. `git clone` our project in your local machine.
2. `Run Plugin` (Either run manually by Gradle -> Run configurations -> runIde or type ./gradlew runIde command in terminal)

2.1 **(If new project is created after step 1, and you want to analyze from this new project)** Delete initially existing `Main.java`

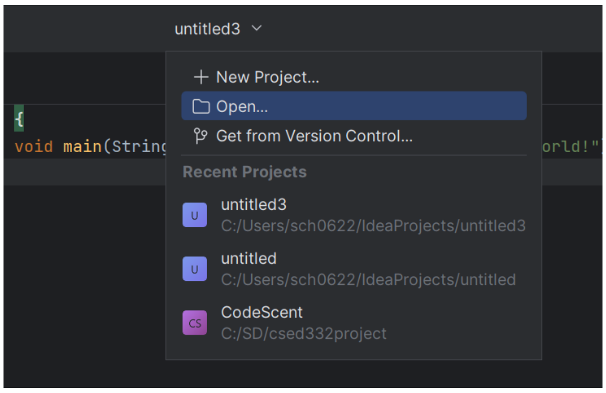


2.2 Create the *main/java* folder under the *src* folder and code under it. **Our plug-in recognizes the .java file in src/main/java.**

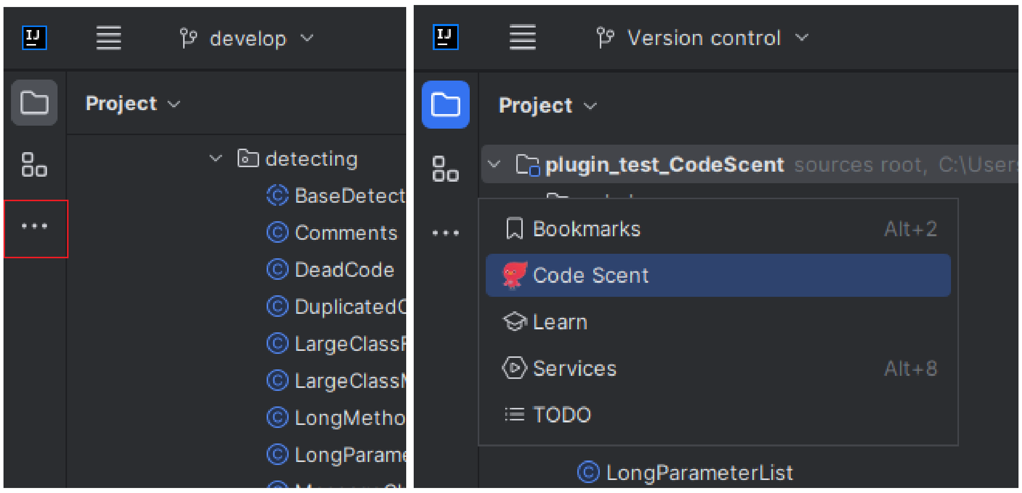


3.1 **(If you want to open an existing project to analyze after step 1)** Click the title of the project on the upper middle of the screen, then click open.

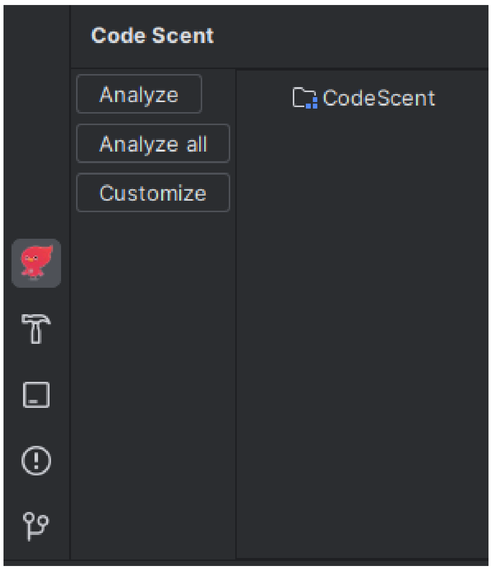
3.2 Then locate the project location that you want to open to analyze code smells.



4. You may find CodeScent icon from more tool windows button.

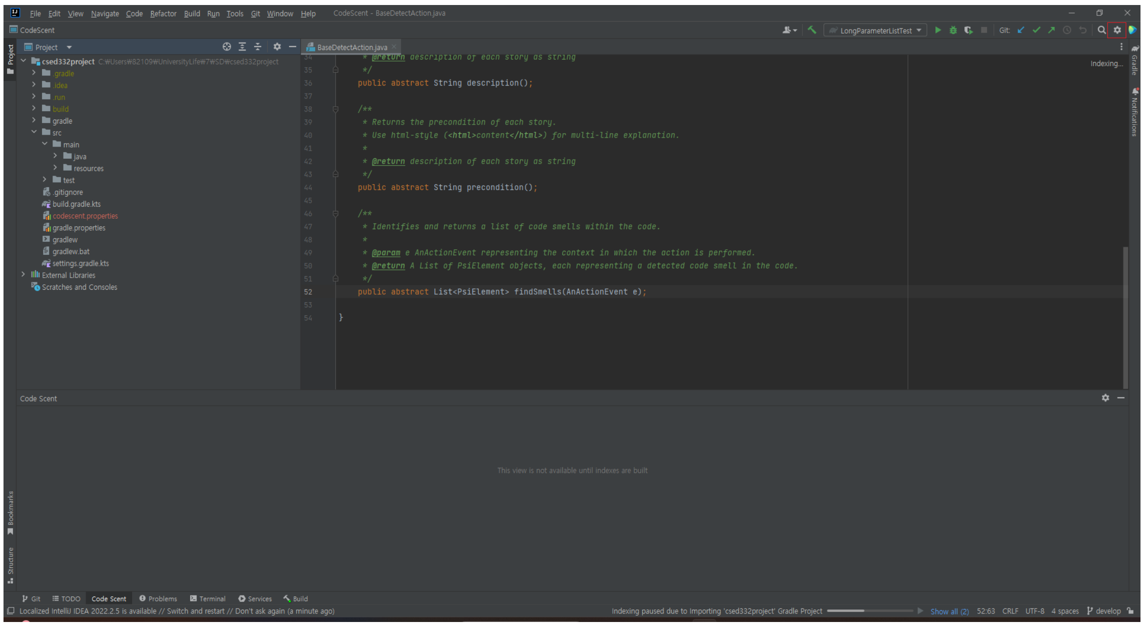


5. Click the ponix Code Scent icon in the left-bottom toolbar.



If your IDE screen UI are like below, follow the steps to synchronize us.

1. Click the settings button located at the upper right corner.



```java
    /**
     * Returns the precondition of each story.
     * Use html-style (<html>content</html>) for multi-line explanation.
     *
     * @return description of each story as string
     */
    public abstract String precondition();

    /**
     * Identifies and returns a list of code smells within the code.
     *
     * @param e AnActionEvent representing the context in which the action is performed.
     * @return A List of PsiElement objects, each representing a detected code smell in the code.
     */
    public abstract List<PsiElement> findSmells(AnActionEvent e);

}
```

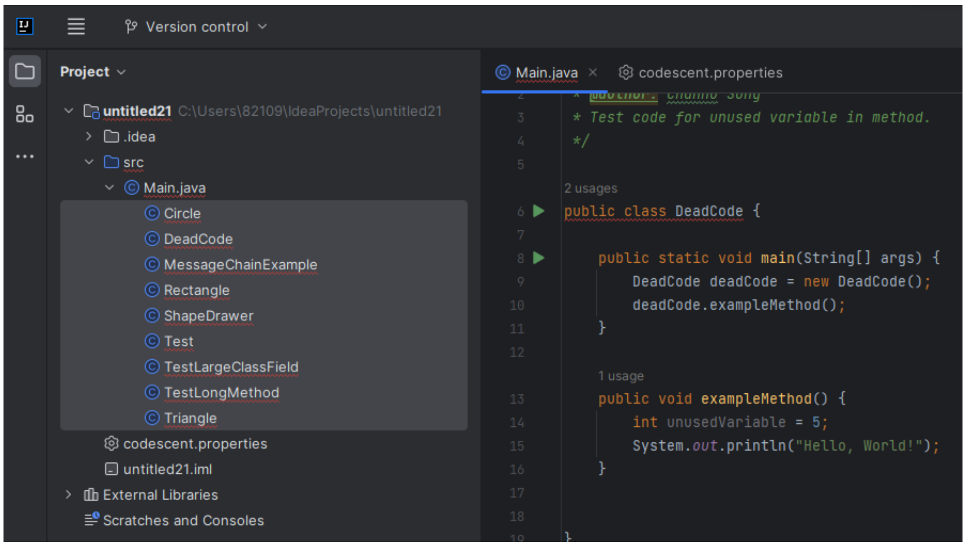
This view is not available until indexes are built

```
Localized IntelliJ IDEA 2022.2.5 is available // Switch and restart // Don't ask again (a minute ago)
Indexing paused due to Importing 'csed332project' Gradle Project
```

2. Appearance & Behavior > New UI Preview > Check Enable New UI > OK > Shutdown now and reload plug-in IDE
3. Start from **step 2.1**

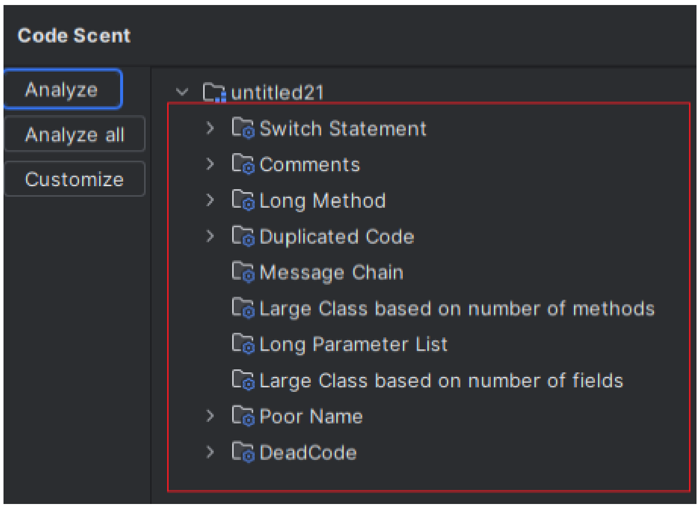
3.2.1 Analyze

1. In Idea project, open a project file that you want to analyze, or like below image, open .java files that you want to analyze under src Main.java directory.

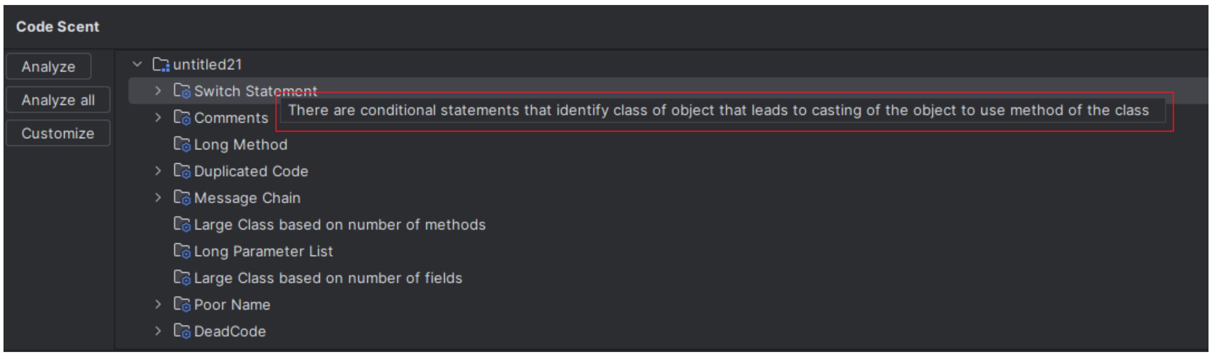


```java
 * Test code for unused variable in method.
 */

public class DeadCode {

    public static void main(String[] args) {
        DeadCode deadCode = new DeadCode();
        deadCode.exampleMethod();
    }

    public void exampleMethod() {
        int unusedVariable = 5;
        System.out.println("Hello, World!");
    }

}
```

2. Double-click Analyze button. You can see code smell directories which have smelly code components in **currently open file**.

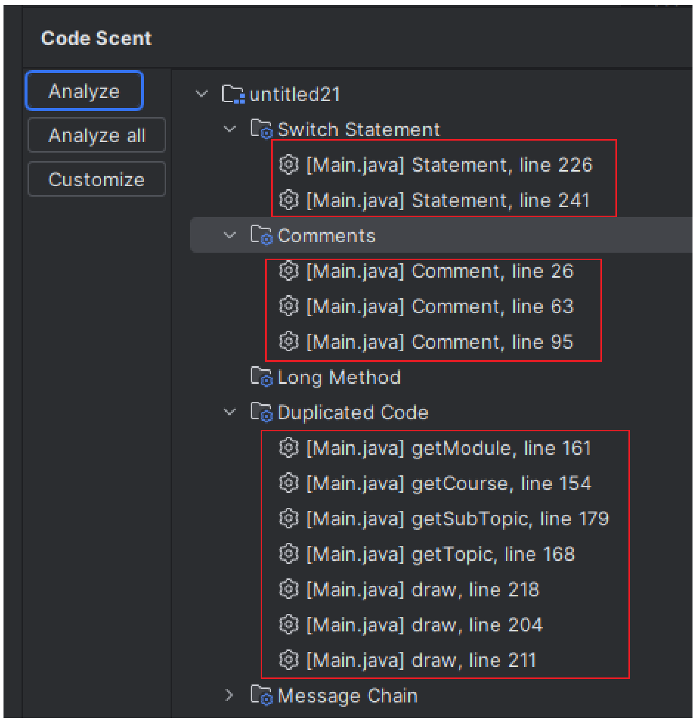


3. Right-click each directory to view the description of that code smell directory.



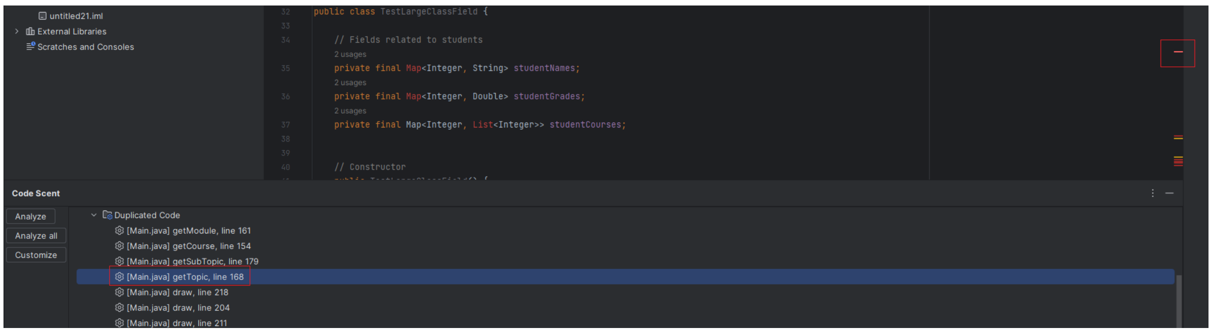
There are conditional statements that identify class of object that leads to casting of the object to use method of the class

4. Double-click each directory to show the components belonging to the corresponding code smell directory.



[Main.java] Statement, line 226
[Main.java] Statement, line 241
[Main.java] Comment, line 26
[Main.java] Comment, line 63
[Main.java] Comment, line 95
[Main.java] getModule, line 161
[Main.java] getCourse, line 154
[Main.java] getSubTopic, line 179
[Main.java] getTopic, line 168
[Main.java] draw, line 218
[Main.java] draw, line 204
[Main.java] draw, line 211

5. If you click on that component, the location of that component will appear as a red bar in the right scroll bar.



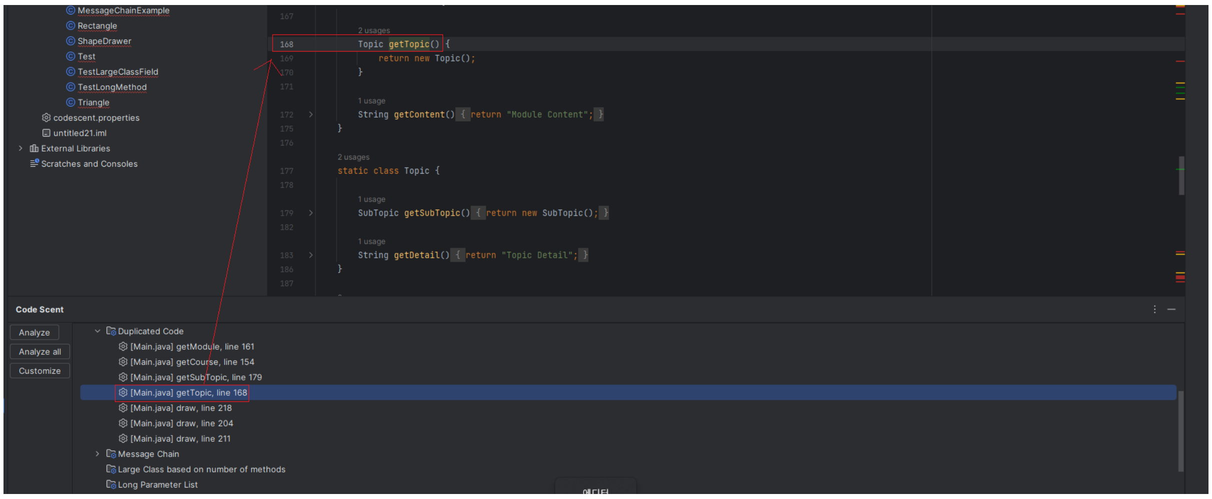
untitled21.iml
External Libraries
Scratches and Consoles

```
public class TestLargeClassField {

    // Fields related to students
    2 usages
    private final Map<Integer, String> studentNames;
    2 usages
    private final Map<Integer, Double> studentGrades;
    2 usages
    private final Map<Integer, List<Integer>> studentCourses;


    // Constructor
```

Code Scent

```
Duplicated Code
    [Main.java] getModule, line 161
    [Main.java] getCourse, line 154
    [Main.java] getSubTopic, line 179
    [Main.java] getTopic, line 168
    [Main.java] draw, line 218
    [Main.java] draw, line 204
    [Main.java] draw, line 211
```

6. Double-click each component to move it to the location of that component.



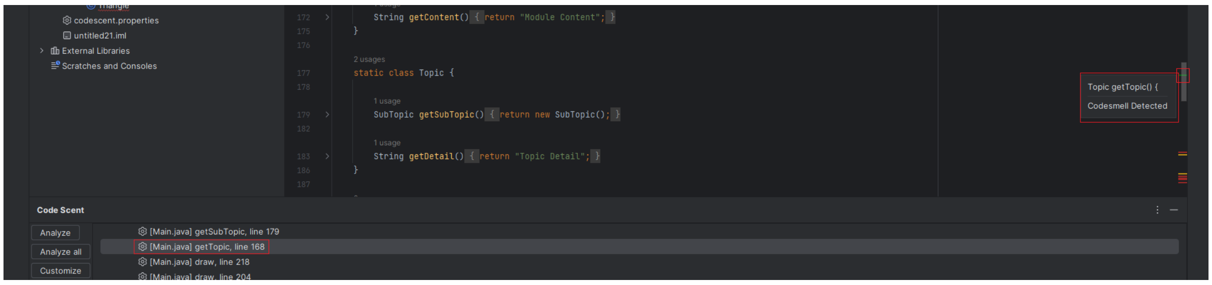
MessageChainExample
Rectangle
ShapeDrawer
Test
TestLargeClassField
TestLongMethod
Triangle
codescent.properties
untitled21.iml
External Libraries
Scratches and Consoles

```
167
        2 usages
168     Topic getTopic() {
            return new Topic();
        }

        1 usage
        String getContent() { return "Module Content"; }
    }

    2 usages
    static class Topic {

        1 usage
        SubTopic getSubTopic() { return new SubTopic(); }

        1 usage
        String getDetail() { return "Topic Detail"; }
    }
```

Code Scent

```
Duplicated Code
    [Main.java] getModule, line 161
    [Main.java] getCourse, line 154
    [Main.java] getSubTopic, line 179
    [Main.java] getTopic, line 168
    [Main.java] draw, line 218
    [Main.java] draw, line 204
    [Main.java] draw, line 211
Message Chain
Large Class based on number of methods
Long Parameter List
```

7. In addition, the red bar we saw in 5 changed to the green bar, and the name of the detected component is shown by hovering the mouse on the bar.



codescent.properties
untitled21.iml
External Libraries
Scratches and Consoles

```
        String getContent() { return "Module Content"; }
    }

    2 usages
    static class Topic {

        1 usage
        SubTopic getSubTopic() { return new SubTopic(); }

        1 usage
        String getDetail() { return "Topic Detail"; }
    }
```

Topic getTopic() {
Codesmell Detected

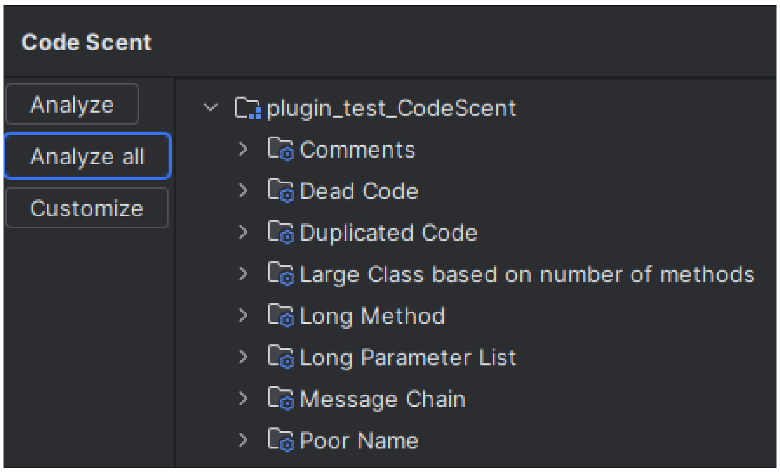
Code Scent

```
[Main.java] getSubTopic, line 179
[Main.java] getTopic, line 168
[Main.java] draw, line 218
[Main.java] draw, line 204
```

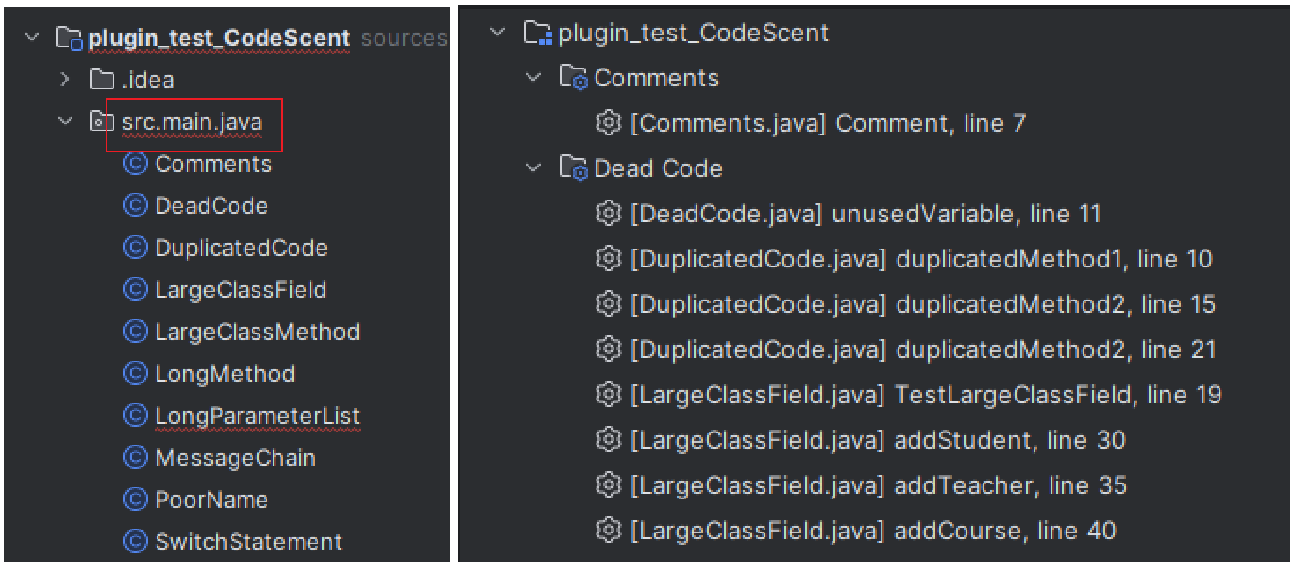
3.2.2 Analyze All

1. Open the idea project that you want to analyze for code smells, and run the plugin (same as step 1 in **3.2.1 Analyze**)

2. Click Analyze All button.



3. You can obtain code smell analysis results for **all .java files in src/main/java directory**.

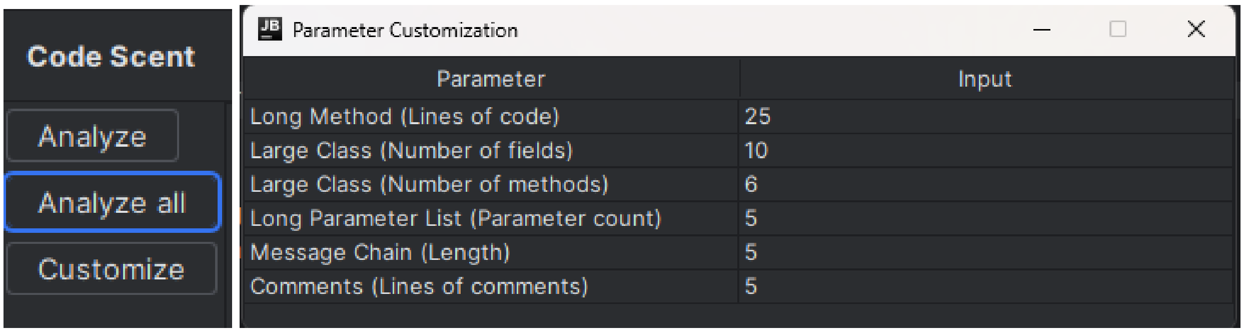


```
[Comments.java] Comment, line 7
[DeadCode.java] unusedVariable, line 11
[DuplicatedCode.java] duplicatedMethod1, line 10
[DuplicatedCode.java] duplicatedMethod2, line 15
[DuplicatedCode.java] duplicatedMethod2, line 21
[LargeClassField.java] TestLargeClassField, line 19
[LargeClassField.java] addStudent, line 30
[LargeClassField.java] addTeacher, line 35
[LargeClassField.java] addCourse, line 40
```

4. Remaining steps work the same as steps from 3 to 7 in **3.2.1 Analyze**.

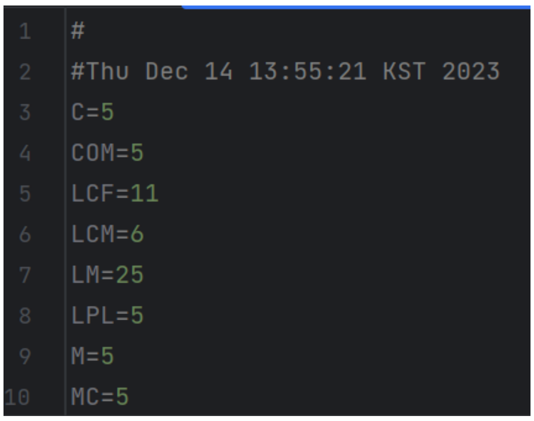
3.2.3 Customize

1. If you click the customize button on the bottom left image, you can get **Parameter Customization window.** Initially, the values in the window are set to default values.

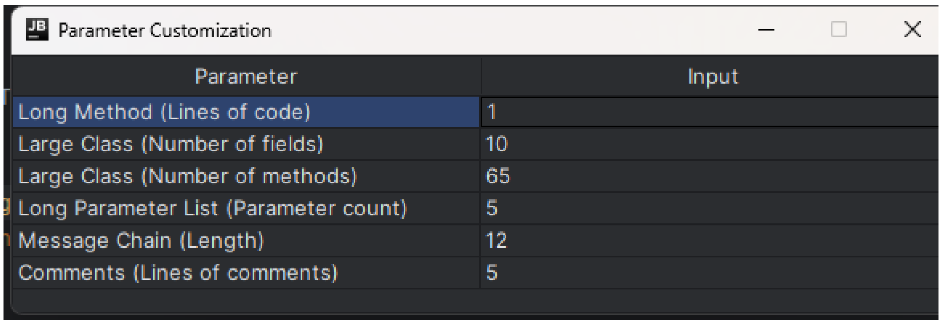


Parameter	Input
Long Method (Lines of code)	25
Large Class (Number of fields)	10
Large Class (Number of methods)	6
Long Parameter List (Parameter count)	5
Message Chain (Length)	5
Comments (Lines of comments)	5

2. If codescent.properties exists and is not in the format below, it may not be loaded. In this case, delete the existing codecent.properties file and then it will be automatically created again correctly.

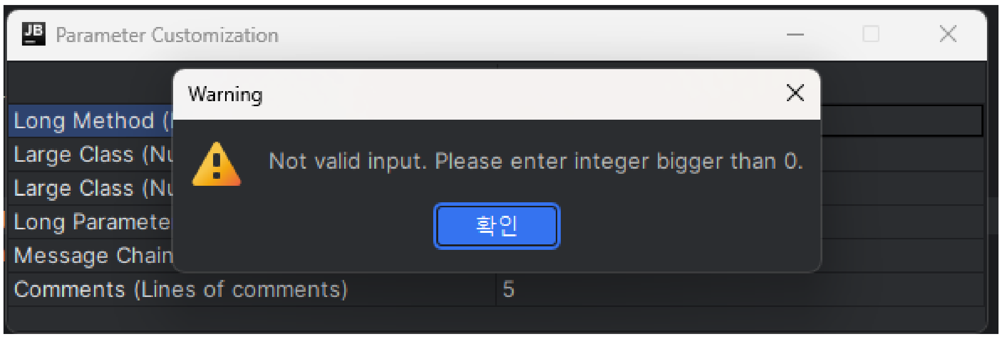

```
#
#Thu Dec 14 13:55:21 KST 2023
C=5
COM=5
LCF=11
LCM=6
LM=25
LPL=5
M=5
MC=5
```

3. You can **freely customize threshold values** by double-clicking on the input tab of each parameter.


Parameter Customization

Parameter	Input
Long Method (Lines of code)	1
Large Class (Number of fields)	10
Large Class (Number of methods)	65
Long Parameter List (Parameter count)	5
Message Chain (Length)	12
Comments (Lines of comments)	5

4. When you input invalid value such as a non-positive value or an alphabet, the window rejects your input showing a warning window.


Parameter Customization

Warning

Not valid input. Please enter integer bigger than 0.

5. If you press the X button, it is set to the desired value.

6. Now, if you analyze your code after customizing the parameters, the detection result for code smells will be based on the parameter values that you customized.