



Guide to understanding

Mistake Detection System
by Prabhsimran Singh



Topics Covered

- What is Mistake Detection System?
- How does it work?
- Which Mistakes it covers?
- A Poster explaining the system
- How is the system tested?
- Understanding the test cases.
- Writing a sample test.

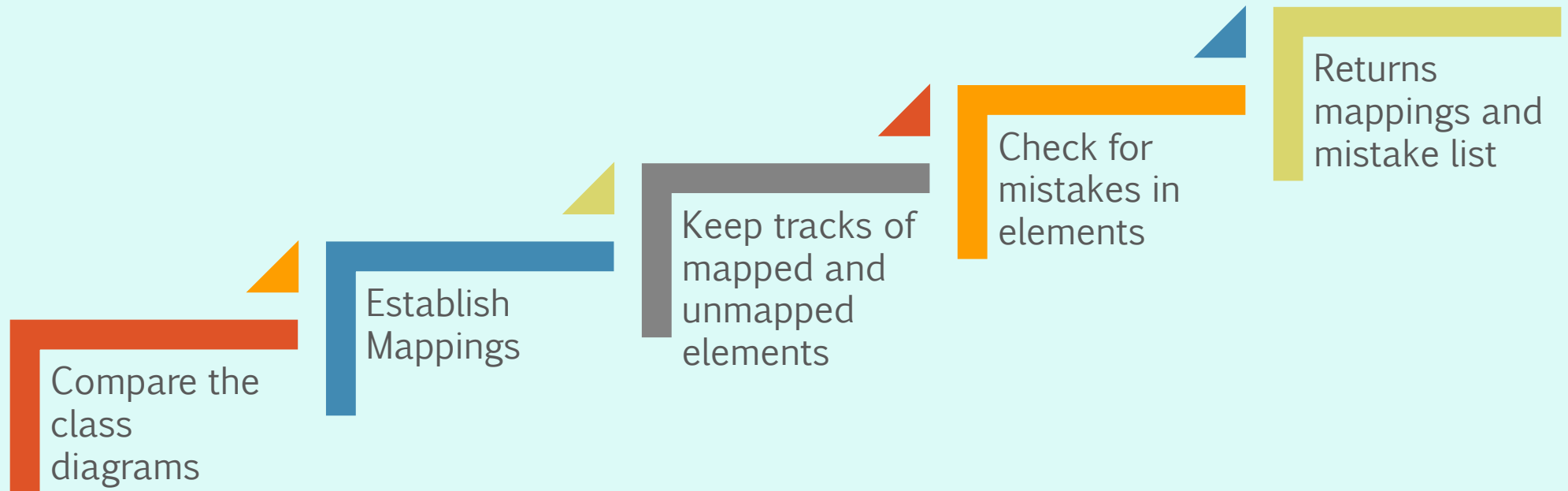


What is Mistake Detection System?

- The Mistake Detection System automates the process of detecting modelling mistakes in domain models by comparing student solutions with a correct solution.
- The automated feedback provided by the mistake detection system allows a larger number of students to receive valuable feedback compared to a manual approach, which is constrained by the availability of teaching staff.



How does it work?



Which Mistakes it covers?

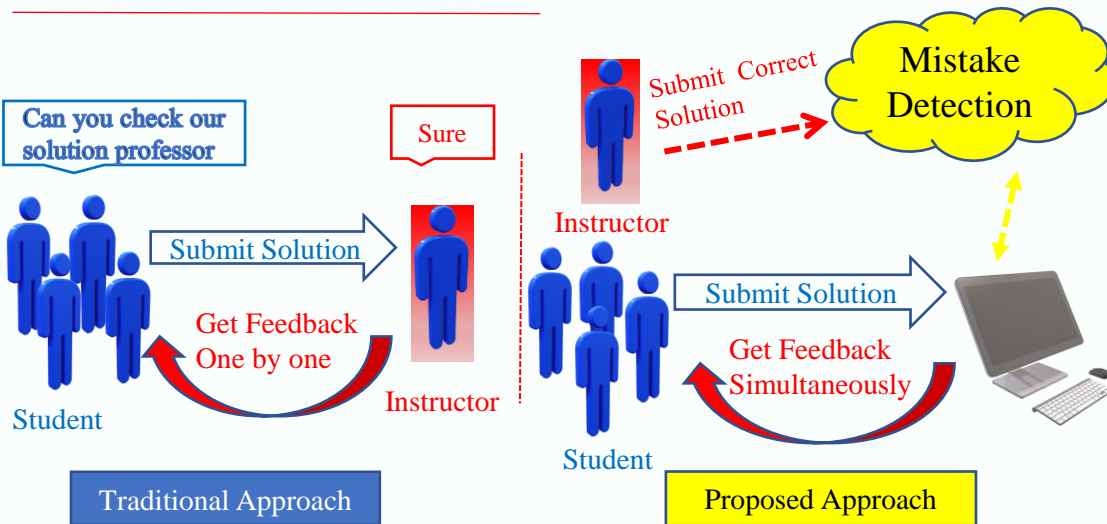
- It will cover 53 different types of Mistakes.
- At present code for 30 mistakes have been written and tested.
(be aware this number will increase as I work more 😊)



Introduction

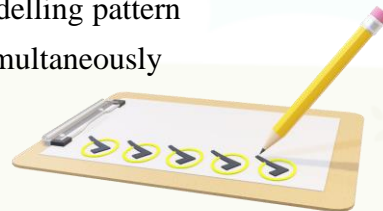
Knowledge about the system's problem domain is crucial for successful system development. Hence, domain modelling with class diagrams is an important Requirement Engineering activity, which is routinely taught in undergraduate and graduate programs. The proposed system automates the process of detecting modelling mistakes in domain models by comparing student solutions with a correct solution.

Problem Statement

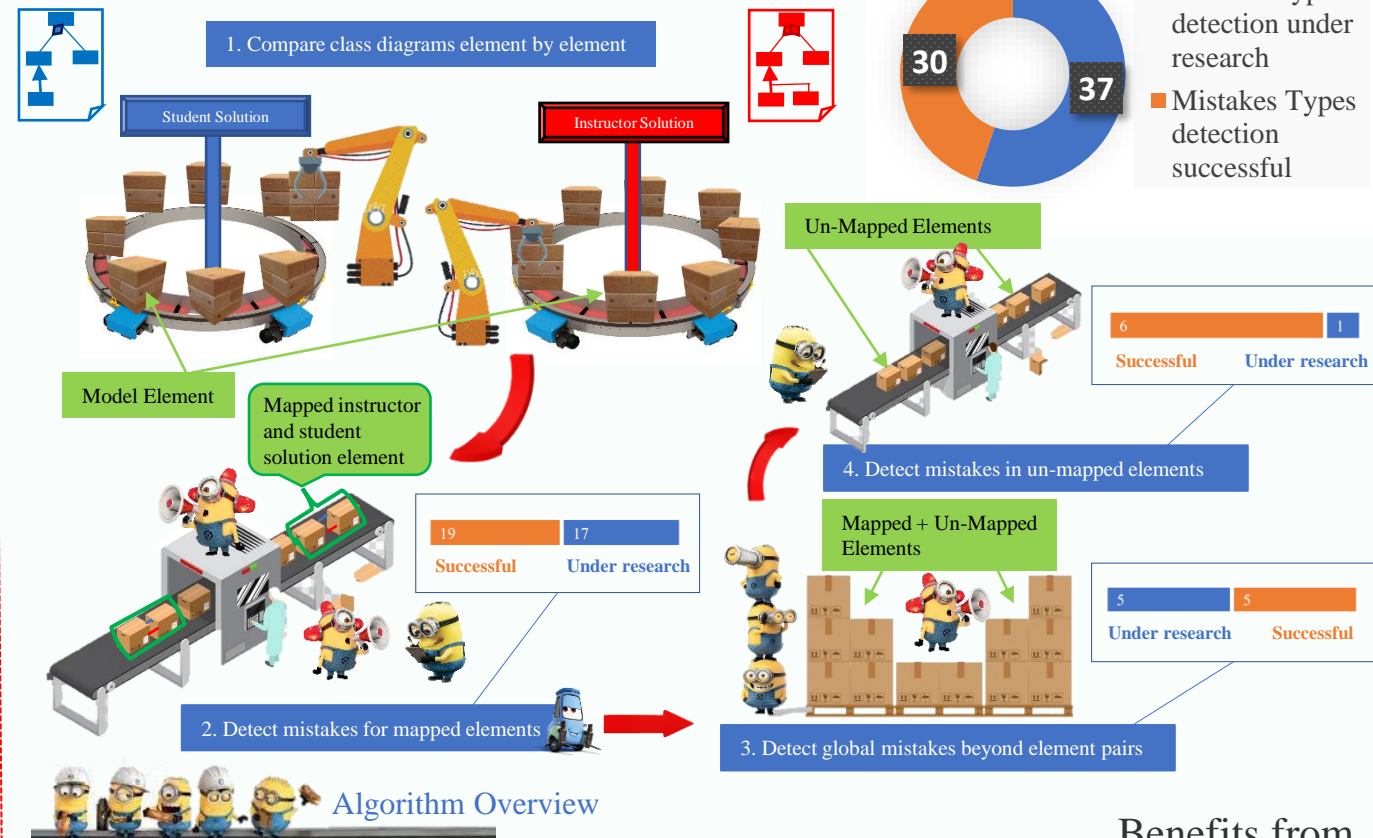


Main Goals and Objectives

- ✓ Detect different types of mistakes in class diagrams such as missing elements, incorrect elements, or incorrect application of modelling pattern
- ✓ Provide valuable feedback to multiple students simultaneously
- ✓ Automate the traditional approach
- ✓ Save student's and instructor's time
- ✓ Scale to large number of students



Current and upcoming state of the research project



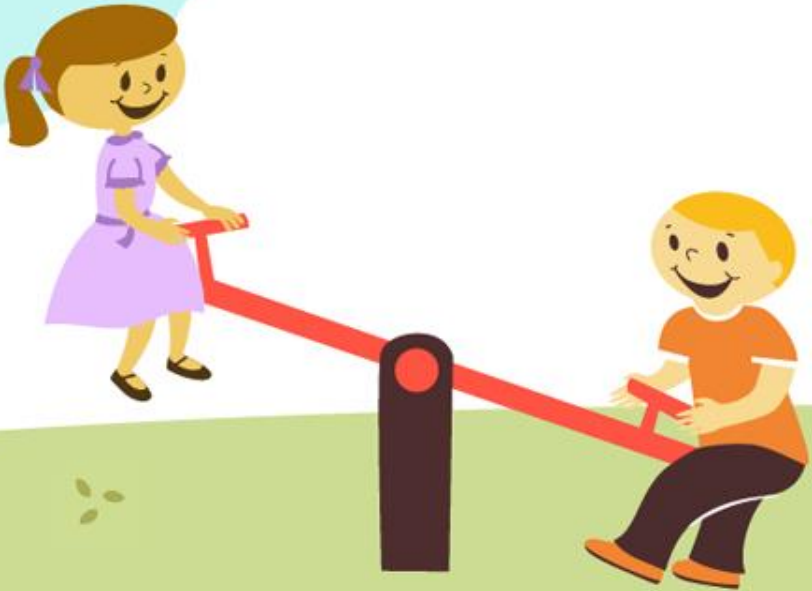
Relevance

Class diagrams are used to describe domain models that help analyze and specify problem domains and requirements. Consequently, modelling skills for class diagrams are a fundamental skill that needs to be learned by engineering students early on in their curriculum. This proposed approach aims to help students practice and improve their modelling skills through an improved learning experience. In addition, the catalog of common domain modelling mistakes may lead to a better understanding of domain modelling.

Benefits from participation



Testing of Mistake Detection



How is the system tested?

- To test the system multiple JUnit tests are created.
- Tests check the correctness of mapping, the number of mistakes, correctness of types of mistakes and the properties of every mistake.



Understanding the test

- In the next few slides will learn about the structure of tests
- Purpose of this section is to make you familiarize with the test
- Every test will have a body, some initializations, function call and assertions

Friendly Caution!!

The slides in this section contains code. In case you feel overwhelmed you can move to next section “Writing a sample test”. You can revisit this section anytime again.



Starts with
“@Test”

Name your test
according to the
mistake you will
test in its body

```
@Test public void testMistakePluralClassName() {  
    }  
}
```

Empty test
structure



Code to load
cdm file

Code may change in future

Name of instructor
solution class
diagram file

```
@Test public void testMistakePluralClassName() {  
    ClassdiagramPackage.eINSTANCE.eClass();  
    var cdmFile = "../mistakedetection/testModels/InstructorSolution/folderName/Instructor_MistakePluralClassName.domain_model.cdm";  
    var resource = ResourceHelper.INSTANCE.loadResource(cdmFile);  
    var classDiagram = (ClassDiagram) resource.getContents().get(0);  
    var maf = ModelingassistantFactory.eINSTANCE;  
    var modelingAssistant = maf.createModelingAssistant();  
    var solution = maf.createSolution();  
    solution.setModelingAssistant(modelingAssistant);  
    solution.setClassDiagram(classDiagram);  
  
    ClassdiagramPackage.eINSTANCE.eClass();  
    var cdmFile1 = "../mistakedetection/testModels/InstructorSolution/folderName/Student_MistakePluralClassName.domain_model.cdm";  
    var resource1 = ResourceHelper.INSTANCE.loadResource(cdmFile1);  
    var classDiagram1 = (ClassDiagram) resource1.getContents().get(0);  
    var maf1 = ModelingassistantFactory.eINSTANCE;  
    var modelingAssistant1 = maf1.createModelingAssistant();  
    var solution1 = maf1.createSolution();  
    solution1.setModelingAssistant(modelingAssistant1);  
    solution1.setClassDiagram(classDiagram1);  
    var student = maf1.createStudent();  
    solution1.setStudent(student);  
}
```

Relative path of cdm file

Similarly, load student
solution class diagram file



In coming slides you will learn
to create a cdm file!!!

Sample test
structure (1/3)

Define the classifier and Attributes you created in cdm file

```
Classifier instructorTestClass = null;  
Attribute instructorTestClassAttributeTestAttribute = null;
```

```
for (var c : classDiagram.getClasses()) {  
    if ("Test".equals(c.getName())) {  
        instructorTestClass = c;  
        for (Attribute a : c.getAttributes()) {  
            if ("testAttribute".equals(a.getName())) {  
                instructorTestClassAttributeTestAttribute = a;  
            }  
        }  
    }  
}
```

Initialize the defined variables

```
Classifier studentTestClass = null;  
Attribute studentTestClassAttributeTestAttribute = null;
```

```
for (var c : classDiagram.getClasses()) {  
    if ("Tests".equals(c.getName())) {  
        studentTestClass = c;  
        for (Attribute a : c.getAttributes()) {  
            if ("testAttribute".equals(a.getName())) {  
                studentTestClassAttributeTestAttribute = a;  
            }  
        }  
    }  
}
```

Similarly, repeat the same for student solution



Sample test structure (2/3)

Call the compare function of Mistake Detection System, it will return an object of comparison class which contains the hashmaps and lists

```
comparison = MistakeDetection.compare(solution, solution1);
```

```
assertEquals(comparison.notMappedInstructorClassifier.size(), 0);  
assertEquals(comparison.extraStudentClassifier.size(), 0);  
assertEquals(comparison.mappedClassifier.size(), 1);
```

These check the correctness of mapping in terms of classifier (class).

```
assertEquals(comparison.mappedClassifier.get(instructorTestClass), studentTestClass);
```

This check if correct elements are mapped

```
assertEquals(comparison.notMappedInstructorAttribute.size(), 0);  
assertEquals(comparison.extraStudentAttribute.size(), 0);  
assertEquals(comparison.duplicateStudentAttribute.size(), 0);  
assertEquals(comparison.mappedAttribute.size(), 1);
```

Similar in case of attributes

```
assertEquals(comparison.mappedAttribute.get(instructorTestClassAttributeTestAttribute),  
             studentTestClassAttributeTestAttribute);
```

```
assertEquals(comparison.newMistakes.size(), 1);  
assertEquals(solution1.getMistakes().size(), 1);
```

Asserting size of detected mistake and Mistakes introduced in class diagram

```
for (Mistake m : solution1.getMistakes()) {  
    if (m.getMistakeType() == MistakeTypes.USING_PLURAL_OR_LOWERCASE  
        && m.getStudentElements().get(0).getElement() == studentTestClass) {  
        assertEquals(m.getStudentElements().get(0).getElement(), studentTestClass);  
        assertEquals(m.getInstructorElements().get(0).getElement(), instructorTestClass);  
        assertEquals(m.getNumDetectionSinceResolved(), 0);  
        assertEquals(m.getNumDetection(), 1);  
        assertFalse(m.isResolved());  
    }  
}
```

Check the correctness of mistake type and its solution element

Sample test structure (3/3)



```
assertEquals(comparison.notMappedInstructorClassifier.size(), 0);
assertEquals(comparison.extraStudentClassifier.size(), 0);
assertEquals(comparison.mappedClassifier.size(), 1);
```

Contains Classes existing in Instructor solution and not in student solution

Contains Classes existing in student solution and not in instructor solution

Contains Classes existing in both Instructor student solution

```
assertEquals(comparison.notMappedInstructorAttribute.size(), 0);
assertEquals(comparison.extraStudentAttribute.size(), 0);
assertEquals(comparison.duplicateStudentAttribute.size(), 0);
assertEquals(comparison.mappedAttribute.size(), 1);
```

Similar case with attribute hash maps

```
assertEquals(comparison.newMistakes.size(), 1);
assertEquals(solution1.getMistakes().size(), 1);
```

Number of mistakes returned by MDS

Number of mistakes associated with a student solution

Explanation of Hash maps and lists used in previous slides



Writing the test

- In the next few slides will learn to write a sample test
- You will also learn to create a cdm file using TouchCORE



This is the home screen of TouchCORE

Click “+” to create new TouchCORE file (in this case .cdm)

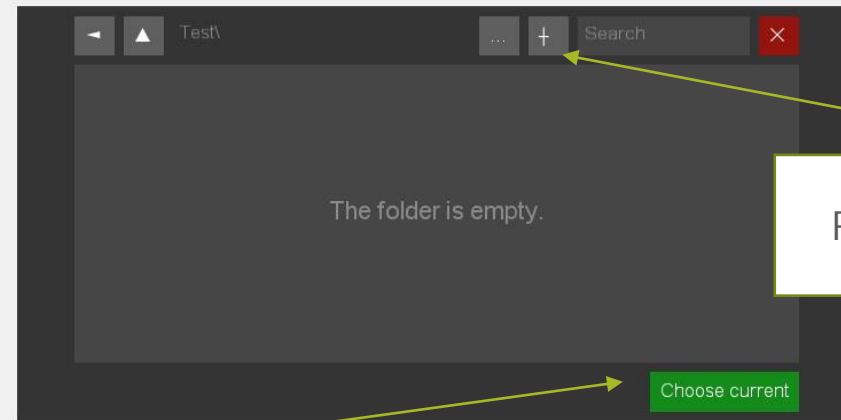
Click here to open a existing TouchCORE file

Step 1: Create a cdm using TouchCORE.





Browse to the location where you want to store the file.



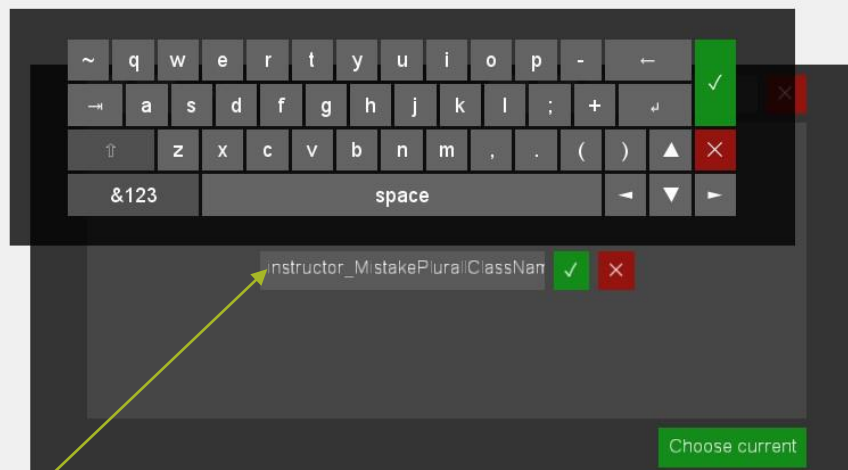
Press “+” to create new folder

Click “Choose Current” to continue at that location

Step 1: Create a cdm using TouchCORE.

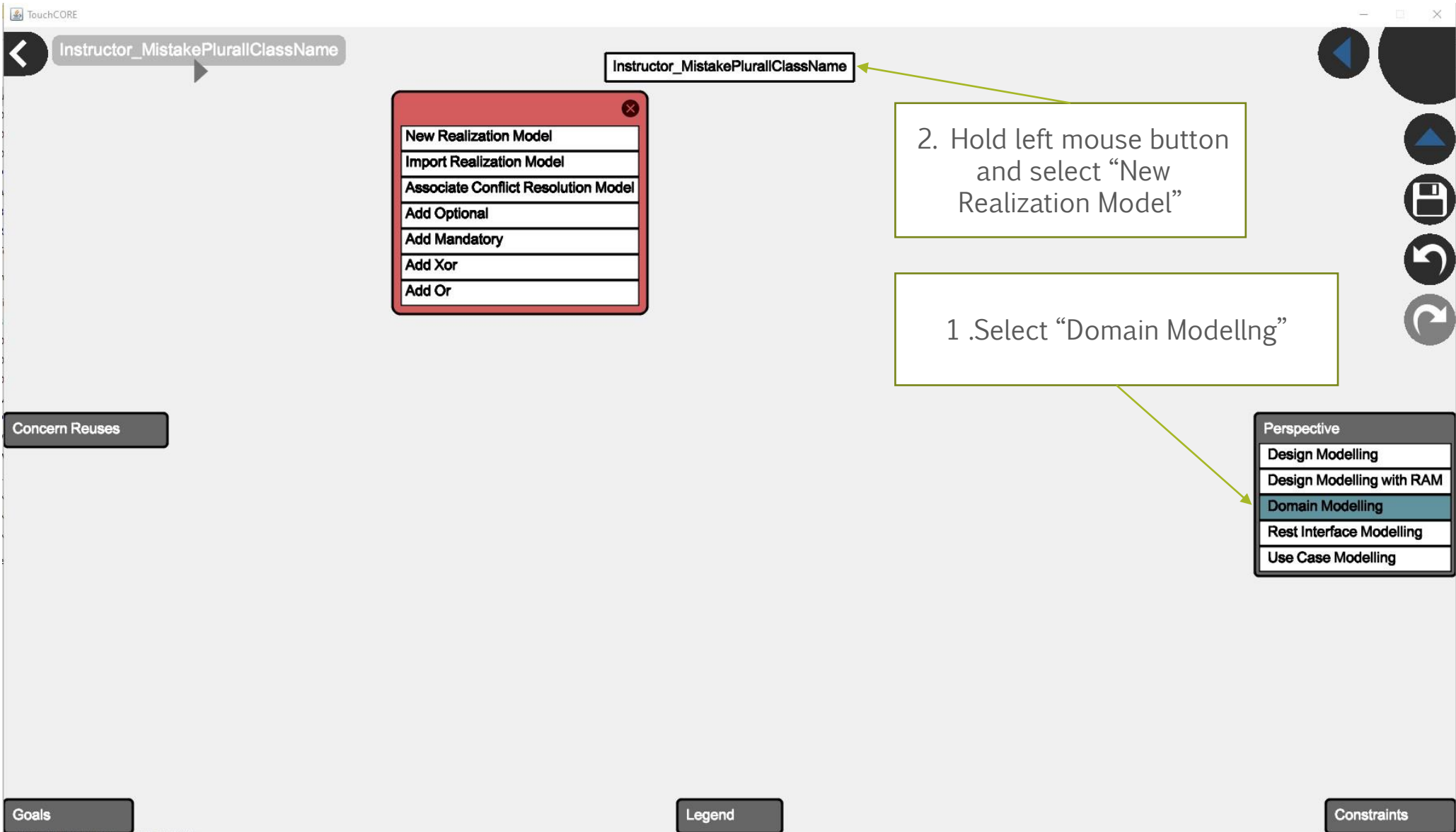


Enter the name of cdm file



!! Name the class according to its projected use. In this example “instructor_MistakePluralClassName” is used as a name, this tells us that, this is an instructor solution and will be used to test Plural class name mistake

Step 1: Create a cdm using TouchCORE.



Step 1: Create a cdm using TouchCORE.



Instructor_MistakePluralClassName

<Instructor_MistakePluralClassName>

: Instructor_MistakePluralClassName



1. Hold left mouse button
and select "Create Class"

Create Class
Create Data Type
Create Enum
Create Note
Import Class
Import Data Type
Import Enum

Extended Design Models

Concern Reuses

Step 1: Create a cdm
using TouchCORE.

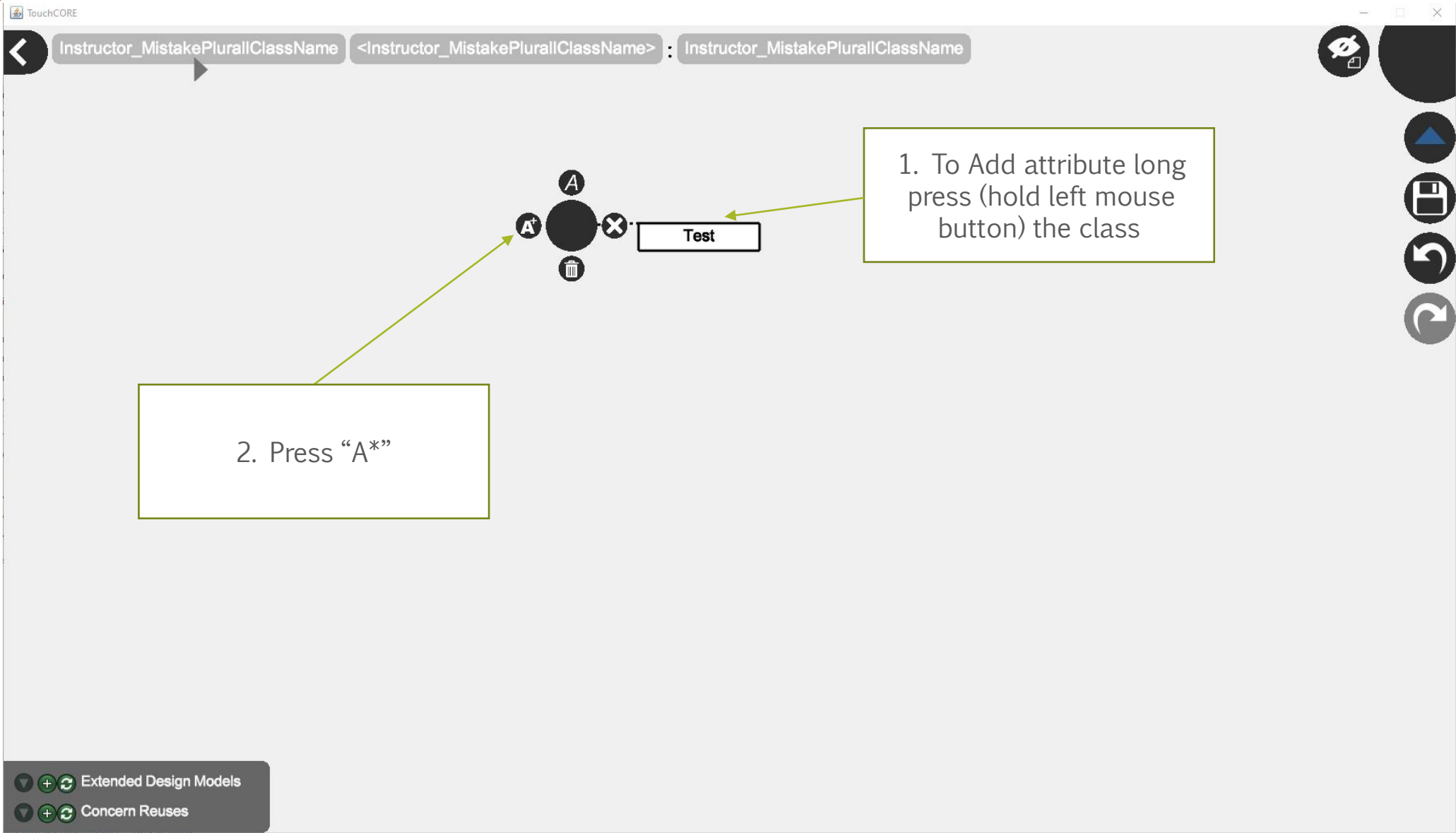
< Instructor_MistakePluralClassName > : Instructor_MistakePluralClassName



1. Name the Class

2. Save

Step 1: Create a cdm
using TouchCORE.

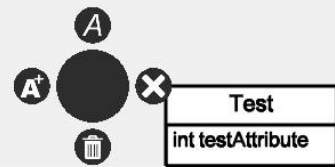


Step 1: Create a cdm using TouchCORE.

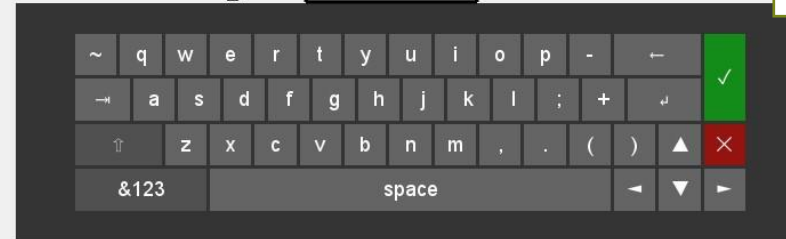


Instructor_MistakePluralClassName

<Instructor_MistakePluralClassName> : Instructor_MistakePluralClassName



1. Enter the data type and name of the attribute



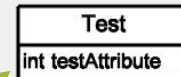
2. Save



Instructor_MistakePluralClassName

<Instructor_MistakePluralClassName>

: Instructor_MistakePluralClassName



Important !!

1. Take a screenshot of the created class diagram. This will help to look at the class diagram in future

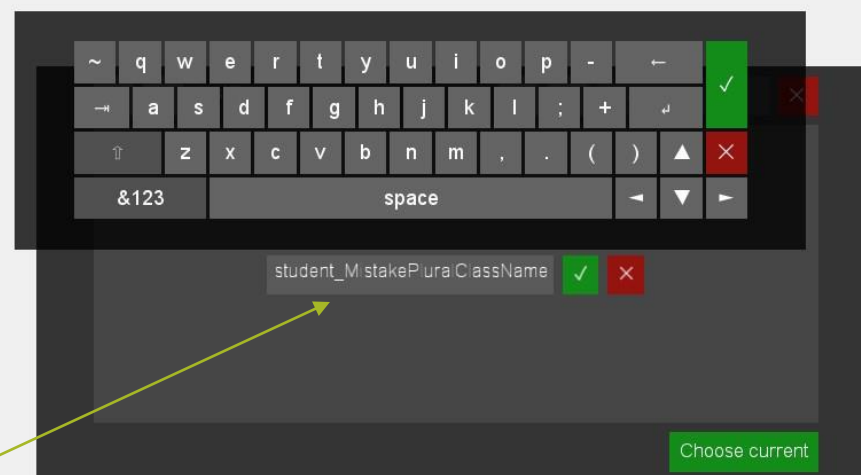
Bravo !! your class diagram is now ready .

2. Save

Note: You can create more classes, in similar way



Now browse to a new location and create a cdm for student solution



!! Name the class according to its projected use.
In this example
“student_MistakePluralClassName” is used as a
name, this tells us that, this is an student
solution and will be used to test Plural class
name mistake

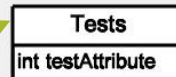
Step 1: Create a cdm
using TouchCORE.



Student_MistakePluralClassName

<Student_MistakePluralClassName>

: Student_MistakePluralClassName



Using the previously learned steps we have create a student solution

Important!!
Note the name of class is “Tests” which is plural, this is done to test the Mistake Detection System

Important !!
Take a screenshot of the created class diagram. This will help to look at the class diagram in future

Extended Design Models

Concern Reuses

Step 1: Create a cdm using TouchCORE.

Instructor – Student Solution Cases

Important !!
Create a PowerPoint presentation and add
the screenshots, for future reference

Test
int testAttribute

instructor_MistakePluralClassName.domain_model

Tests
int testAttribute





student_MistakePluralClassName.domain_model

Sample Slide



Step 1: Create a cdm
using TouchCORE.

> R work > Test Cases > test2

Name	Status	Date modified	Type	Size
 instructor_MistakePluralClassName		29-05-2021 07:30 PM	File folder	
 student_MistakePluralClassName		29-05-2021 07:37 PM	File folder	

This is how the folders will look at the saved location

> R work > Test Cases > test2 > instructor_MistakePluralClassName > Class Diagram

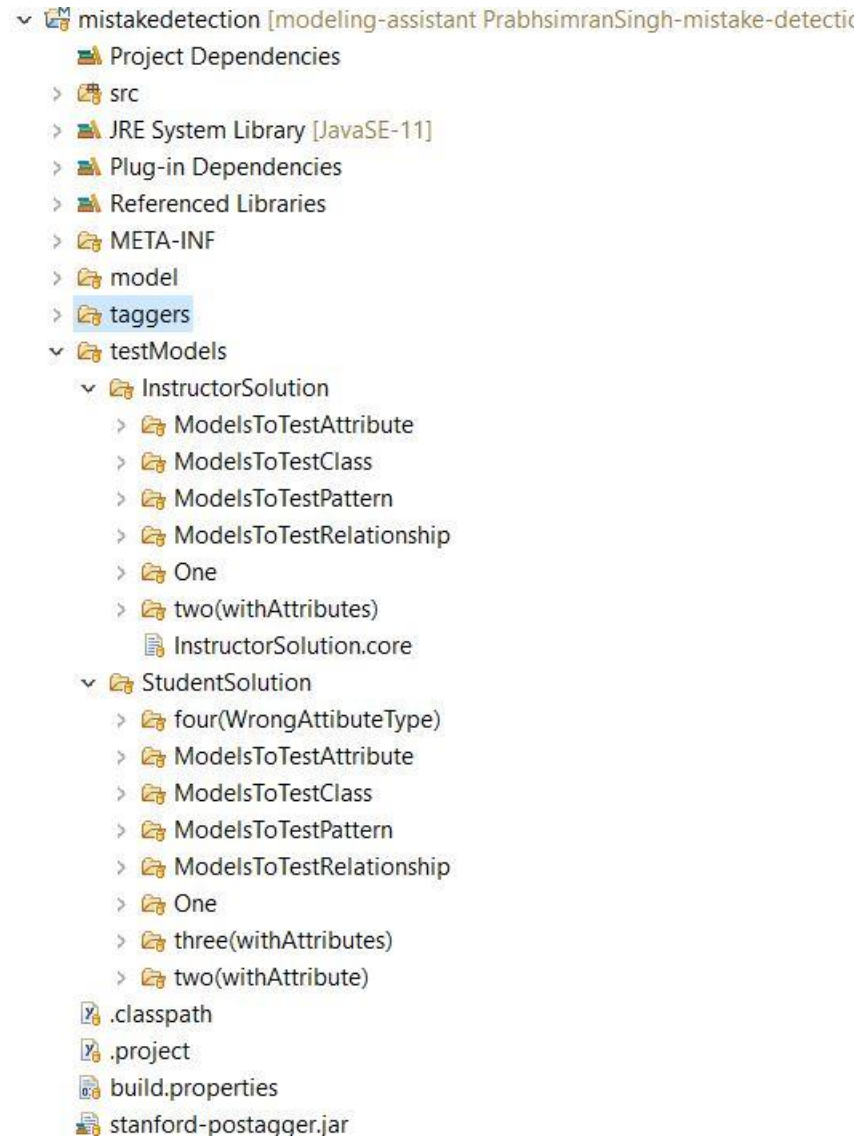
Name	Status	Date modified	Type	Size
 Instructor_MistakePluralClassName.domain_model.cdm		29-05-2021 07:36 PM	CDM File	2 KB
































top > R work > Test Cases > test2 > student_MistakePluralClassName > Class Diagram

Name	Status	Date modified	Type	Size
 Student_MistakePluralClassName.domai...		29-05-2021 07:37 PM	CDM File	2 KB

The files we require for testing (.cdm)

Step 1: Create a cdm using TouchCORE.



- ▼  mistakedetection [modeling-assistant PrabhsimranSingh-mistake-detectic
 -  Project Dependencies
 - >  src
 - >  JRE System Library [JavaSE-11]
 - >  Plug-in Dependencies
 - >  Referenced Libraries
 - >  META-INF
 - >  model
 - >  taggers
 - ▼  testModels
 - ▼  InstructorSolution
 - >  ModelsToTestAttribute
 - >  ModelsToTestClass
 - >  ModelsToTestPattern
 - >  ModelsToTestRelationship
 - >  One
 - >  two(withAttributes)
 -  InstructorSolution.core
 - ▼  StudentSolution
 - >  four(WrongAttributeType)
 - >  ModelsToTestAttribute
 - >  ModelsToTestClass
 - >  ModelsToTestPattern
 - >  ModelsToTestRelationship
 - >  One
 - >  three(withAttributes)
 - >  two(withAttribute)
 -  .classpath
 -  .project
 -  build.properties
 -  stanford-postagqer.jar

Copy the .cdm to the folder according to the mistake to be tested

In this example the instructor solution file will go to:
testModels->InstructorSolution->ModelsToTestClass

And the student solution file will go to:
testModels->StudentSolution->ModelsToTestClass

Step 2: Copying File to project

```
▼ > mistakedetection.tests [modeling-assistant PrabhsimranSingh-mistake-d
  ▼ > src
    ▼ > ca.mcgill.sel.mistakedetection.tests
      > MistakeDetectionFunctionLogicTest.java
      > MistakeDetectionPatternTest.java
      > MistakeDetectionTest.java
      > MistakeDetectionWrongAttributeTest.java
      > MistakeDetectionWrongClassTest.java
      > MistakeDetectionWrongRelationshipsTest.java
    > JRE System Library [JavaSE-11]
    > Plug-in Dependencies
```

Go to the Mistake appropriate
java File to write a test

In this example, you will write test in
“MistakeDetectionWrongClassTest”

Step 3: Writing Test

Starts with
“@Test”

Name your test
according to the
mistake you will
test in its body

```
@Test public void testMistakePluralClassName() {  
    }  
}
```

Step 3: Writing a
test



1. Load cdm file

Name of instructor solution class diagram file

```
@Test public void testMistakePluralClassName() {  
    ClassdiagramPackage.eINSTANCE.eClass();  
    var cdmFile = "../mistakedetection/testModels/InstructorSolution/folderName/Instructor_MistakePluralClassName.domain_model.cdm";  
    var resource = ResourceHelper.INSTANCE.loadResource(cdmFile);  
    var classDiagram = (ClassDiagram) resource.getContents().get(0);  
    var maf = ModelingassistantFactory.eINSTANCE;  
    var modelingAssistant = maf.createModelingAssistant();  
    var solution = maf.createSolution();  
    solution.setModelingAssistant(modelingAssistant);  
    solution.setClassDiagram(classDiagram);  
}
```

```
ClassdiagramPackage.eINSTANCE.eClass();  
var cdmFile1 = "../mistakedetection/testModels/InstructorSolution/folderName/Student_MistakePluralClassName.domain_model.cdm";  
var resource1 = ResourceHelper.INSTANCE.loadResource(cdmFile1);  
var classDiagram1 = (ClassDiagram) resource1.getContents().get(0);  
var maf1 = ModelingassistantFactory.eINSTANCE;  
var modelingAssistant1 = maf1.createModelingAssistant();  
var solution1 = maf1.createSolution();  
solution1.setModelingAssistant(modelingAssistant1);  
solution1.setClassDiagram(classDiagram1);  
var student = maf1.createStudent();  
solution1.setStudent(student);
```

Relative path of cdm file

Similarly, load student solution class diagram file

Step 3: Writing a test



2. Define the classifier and Attributes you created in cdm file

```
Classifier instructorTestClass = null;  
Attribute instructorTestClassAttributeTestAttribute = null;
```

```
for (var c : classDiagram.getClasses()) {  
    if ("Test".equals(c.getName())) {  
        instructorTestClass = c;  
        for (Attribute a : c.getAttributes()) {  
            if ("testAttribute".equals(a.getName())) {  
                instructorTestClassAttributeTestAttribute = a;  
            }  
        }  
    }  
}
```

```
Classifier studentTestClass = null;  
Attribute studentTestClassAttributeTestAttribute = null;
```

```
for (var c : classDiagram.getClasses()) {  
    if ("Tests".equals(c.getName())) {  
        studentTestClass = c;  
        for (Attribute a : c.getAttributes()) {  
            if ("testAttribute".equals(a.getName())) {  
                studentTestClassAttributeTestAttribute = a;  
            }  
        }  
    }  
}
```

3. Initialize the defined variables

4. Similarly, repeat the same for student solution

Step 3: Writing a test



5. Call the compare function of Mistake Detection System, it will return an object of comparison class which contains the hashmaps and lists

```
comparison = MistakeDetection.compare(solution, solution1);
```

```
assertEquals(comparison.notMappedInstructorClassifier.size(), 0);  
assertEquals(comparison.extraStudentClassifier.size(), 0);  
assertEquals(comparison.mappedClassifier.size(), 1);
```

```
assertEquals(comparison.mappedClassifier.get(instructorTestClass), studentTestClass);
```

```
assertEquals(comparison.notMappedInstructorAttribute.size(), 0);  
assertEquals(comparison.extraStudentAttribute.size(), 0);  
assertEquals(comparison.duplicateStudentAttribute.size(), 0);  
assertEquals(comparison.mappedAttribute.size(), 1);
```

```
assertEquals(comparison.mappedAttribute.get(instructorTestClassAttributeTestAttribute),  
             studentTestClassAttributeTestAttribute);
```

```
assertEquals(comparison.newMistakes.size(), 1);  
assertEquals(solution1.getMistakes().size(), 1);
```

```
for (Mistake m : solution1.getMistakes()) {  
    if (m.getMistakeType() == MistakeTypes.USING_PLURAL_OR_LOWERCASE  
        && m.getStudentElements().get(0).getElement() == studentTestClass) {  
        assertEquals(m.getStudentElements().get(0).getElement(), studentTestClass);  
        assertEquals(m.getInstructorElements().get(0).getElement(), instructorTestClass);  
        assertEquals(m.getNumDetectionSinceResolved(), 0);  
        assertEquals(m.getNumDetection(), 1);  
        assertFalse(m.isResolved());  
    }  
}
```

5. Write assertions to check the mapping (Test = Tests).

This check if correct elements are mapped

Similar in case of attributes

6. Assert the size of detected mistake and Mistakes introduced in class diagram

7. Check the correctness of mistake type and its solution element

Step 3: Writing a test



Thank you and have fun using Mistake
Detection System

