jStar Eclipse tutorial

September 28, 2011

1 Installation

Prerequisites:

- JDK 6 (not JRE since it does not have a compiler needed for annotation processing). You can specify it in eclipse.ini:

  Windows Example
  -vm
  C:\Java\JDK\1.6\bin\javaw.exe

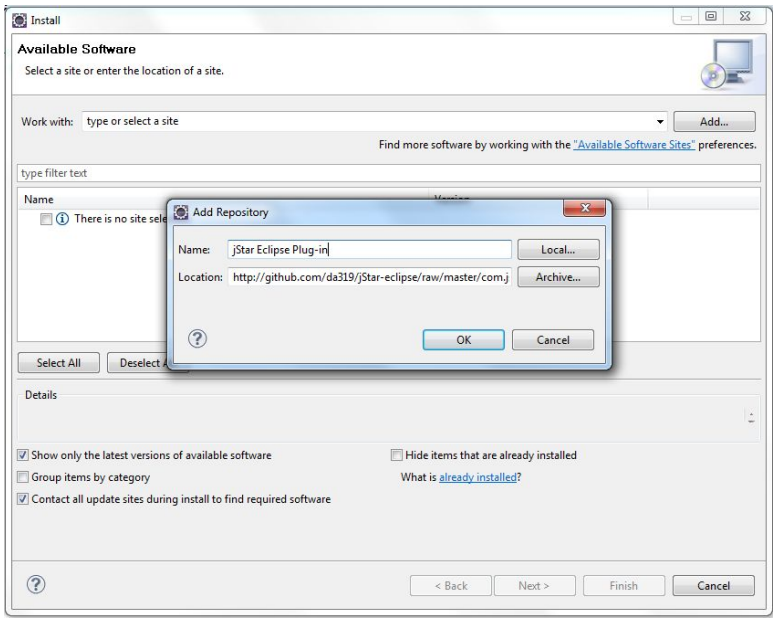
  Linux Example
  -vm
  /opt/sun-jdk-1.6.0.02/bin/java

  Mac Example
  -vm
  /System/Library/Frameworks/JavaVM.framework/Versions/1.6.0/Home/bin/java

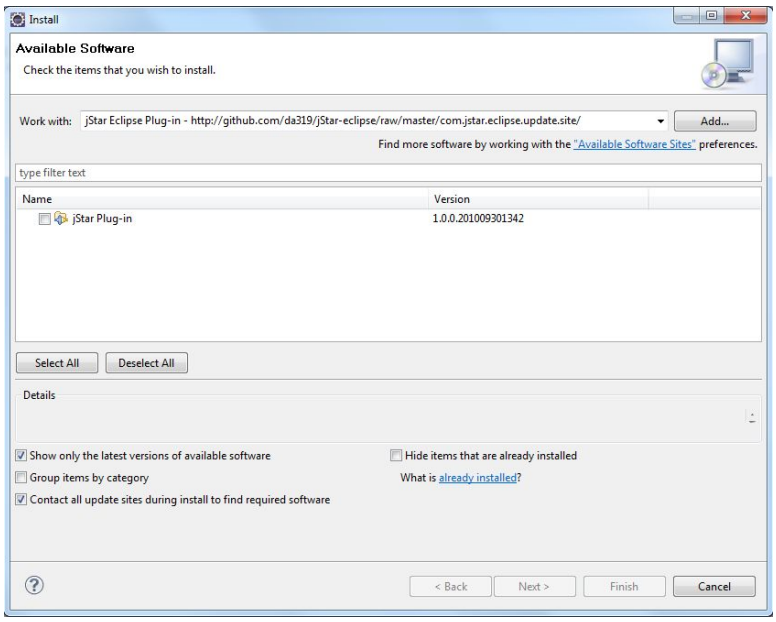
  For more information go to http://wiki.eclipse.org/Eclipse.ini

Two ways:

1. Update site (Recommended). Go to **Help** → **Install New Software...**.
   Click **Add...** and type in the name and update site for the plug-in.
   The update site for the jStar Eclipse Plug-in is
   http://github.com/seplogic/jstar-eclipse/raw/master/com.jstar.eclipse.update.site/
   Press **OK**.
   Uncheck **Group items by category**.



The jStar Eclipse Plug-in should appear, as the following figure shows.



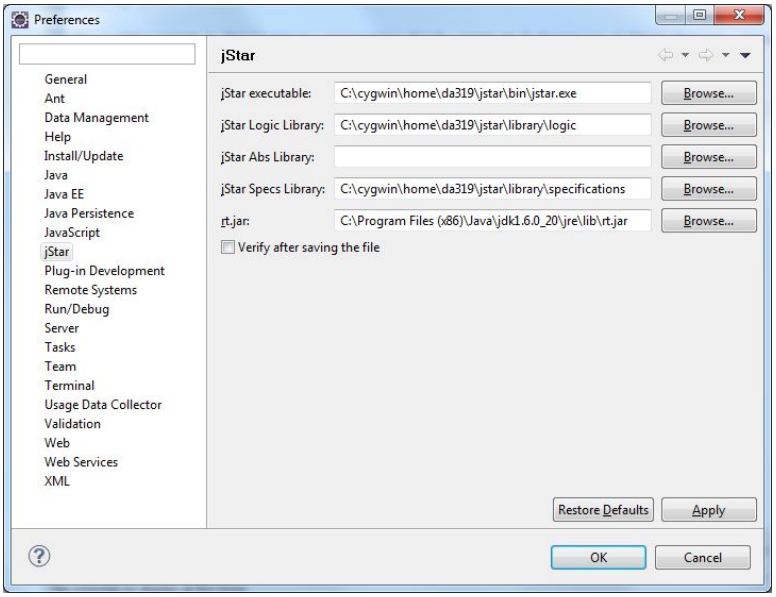
Select the plug-in and click **Next**.
Click **Next** in the following page. Accept the terms of the license agreement and click **Finish**.

2. Manually. Add the latest plug-in jar file **com.jstar.eclipse.update.site/plugins/com.jstar.eclipse_1.0.0.x.jar** to `eclipse/dropins/` folder and restart Eclipse.

2 Configuration

2.1 Windows

Go to Window → Preferences → jStar and set the required directories.



rt.jar could be found in jdk1.6.0/jre/lib/. It is required library for soot. The plug-in will try to find it automatically.

2.2 Linux

rt.jar could be found in jdk1.6.0/jre/lib/. It is required library for soot. The plug-in will try to find it automatically.

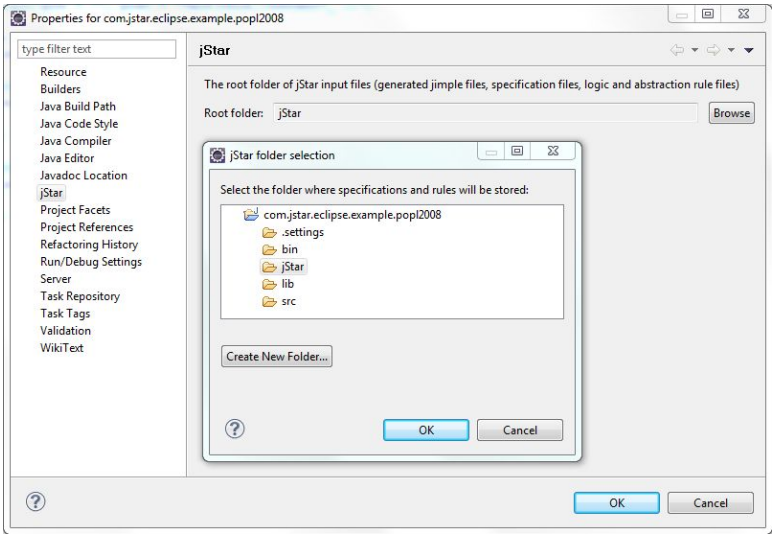
2.3 Mac

classes.jar and ui.jar could be found in /System/Library/Frameworks/JavaVM.framework/Versions/1.6.0/Classes/. They are required libraries for soot. The plug-in will try to find them automatically.

3 Structure

3.1 jStar root folder

All jStar input files (specification, logic rules, abstraction rules, generated jimple files) are stored in jStar root folder. To specify jStar root folder open project context menu, select **Properties** → **jStar**.



3.2 External classes

To add a specification for an external class (e.g. java.lang.Object), select **Add specification for the external class...**. This command can be found in

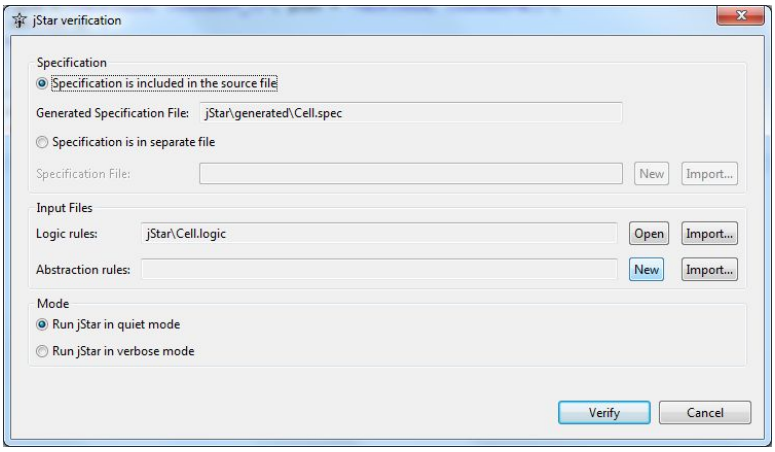
- The context menu of the java project
- The context menu of the java source file → **jStar Verification**
- In the main toolbar

This will create and open spec, logic and abs files where you can write specification, logic and abstraction rules. These files will be created in jStar root folder depending on the package of the class. For example, if the jStar root folder is **jStar** and you are creating specification for java.lang.Object, input files will be created in **jStar/java/lang/**.

4 Verification

You can verify source file by selecting `Verify with jStar` from the context menu or the main toolbar.

By selecting `Verify with jStar Configurations...`, you can indicate specifications, logic and abstraction rules.



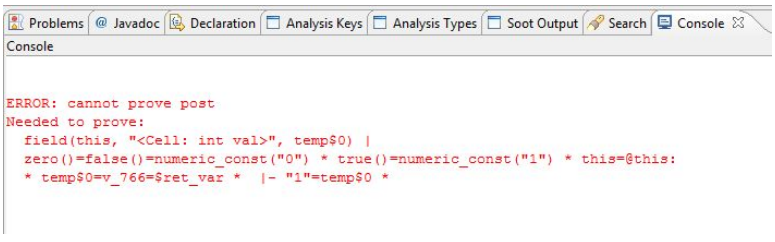
In the window above you can create a new empty file or import a file for specification, logic and abstraction rules. The location depends on the location of the source file and could not be changed. Files are are contained in jStar root folder **??** and locations shown are relative to the project.

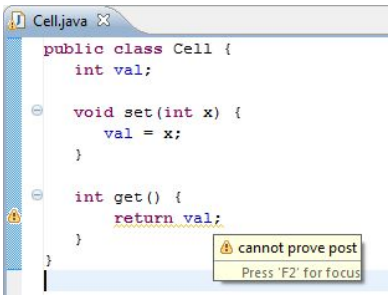
4.1 Specification in source file

If you want to write specification in the source file, you need to add annotations.jar (can be found in com.jstar.eclipse.annotations / jar file) to your project Java Build Path. More information about annotations could be found in **??** .

4.2 Verification errors

In case there are some verification errors, you can see error messages in console. The lines in source code where the problem appeared are annotated as squiggly marks.





5 Annotation Processing

Annotations

- `@Import` has one element `String[] value`. You need to write a name of the class (including package declaration) which specification you want to import. This annotation can be used to annotate only type declarations.
- `@Predicate` is used for `define` and `export` statements. It has three elements: `String predicate`, `String formula`, `DefinitionType type`. `DefinitionType` is enum with two values `Define` and `Export`. The default value of type is `DefinitionType.Define`. This annotation can be used to annotate only type declarations.
- `@Predicates` is used if you want to have more than one `define` and/or `export` statements. It has one element `Predicate[] value`. This annotation can be used to annotate only type declarations.
- `@InitSpec` is a (dynamic / both static and dynamic) specification for constructor which is not explicitly defined in the source code. It has two elements: `String pre`, `String post`. This annotation can be used to annotate only type declarations.
- `@InitSpecs` is (dynamic / both static and dynamic) specifications which are combined with `also` for constructor which is not explicitly defined in the source code. It has one element `InitSpec[] value`. This annotation can be used to annotate only type declarations.
- `@InitSpecStatic` is a static specification for constructor which is not explicitly defined in the source code. It has two elements: `String pre`, `String post`. This annotation can be used to annotate only type declarations.
- `@InitSpecsStatic` is static specifications which are combined with `also` for constructor which is not explicitly defined in the source code. It has one element `InitSpecStatic[] value`. This annotation can be used to annotate only type declarations.

- `@Spec` is a (dynamic / both static and dynamic) specification for a method or a constructor. It has two elements: `String pre`, `String post`. This annotation can be used to annotate only method and constructor declarations.
- `@Specs` is (dynamic / both static and dynamic) specifications which are combined with `also` for a method or a constructor. It has one element: `Spec[] value`. This annotation can be used to annotate only method and constructor declarations.
- `@SpecStatic` is a static specification for a method or a constructor. It has two elements: `String pre`, `String post`. This annotation can be used to annotate only method and constructor declarations.
- `@SpecsStatic` is static specifications which are combined with `also` for a method or a constructor. It has one element: `SpecStatic[] value`. This annotation can be used to annotate only method and constructor declarations.

Examples of annotations in the source code:

Annotation in source file	Generated specification file
`@Import("java.lang.Object")`	`import("java/lang/Object.spec");`
`@Import({"Spec", "java.lang.Object"})`	`import("Spec.spec");` `import("java/lang/Object.spec");`

`@Predicate(`
`  predicate = "P(x)",`
`  formula = "F(x)"`
`)`
	`define P(x) as F(x);`

`@Predicate(`
`  predicate = "P(x)",`
`  formula = "F(x)",`
`  type = DefinitionType.Export`
`)`
	`export P(x) as F(x);`

```
@Predicates({
   @Predicate(
      predicate = "P1(x)",
      formula = "F1(x)",
      type = DefinitionType.Export
   ),
   @Predicate(
      predicate = "P2(x)",
      formula = "F2(x)"
   )
})
```

```
export P1(x) as F1(x);
define P2(x) as F2(x);
```

```
@InitSpec(
   pre = "precondition",
   post = "postcondition"
)
```

```
void <init>() :
   { precondition }
   { postcondition }
```

```
@InitSpecs({
   @InitSpec(
      pre = "precondition 1",
      post = "postcondition 1"
   ),
   @InitSpec(
      pre = "precondition 2",
      post = "postcondition 2"
   )
})
```

```
void <init>() :
   { precondition 1 }
   { postcondition 1 }
   andalso
   { precondition 2 }
   { postcondition 2 }
```

```
@InitSpecStatic(
   pre = "precondition",
   post = "postcondition"
)
```

```
void <init>() static :
   { precondition }
   { postcondition }
```

```
@InitSpecsStatic({
   @InitSpecStatic(
      pre = "precondition 1",
      post = "postcondition 1"
   ),
   @InitSpecStatic(
      pre = "precondition 2",
      post = "postcondition 2"
   )
})
```

```
void <init>() static :
   { precondition 1 }
   { postcondition 1 }
   andalso
   { precondition 2 }
   { postcondition 2 }
```

```
@Spec(
   pre = "precondition",
   post = "postcondition"
)
```

method declaration

method declaration :

```
   { precondition }
   { postcondition }
```

```
@Specs({
   @Spec(
      pre = "precondition 1",
      post = "postcondition 1"
   ),
   @Spec(
      pre = "precondition 2",
      post = "postcondition 2"
   )
})
```

method declaration

method declaration :

```
   { precondition 1 }
   { postcondition 1 }
   andalso
   { precondition 2 }
   { postcondition 2 }
```

```
@SpecStatic(
   pre = "precondition",
   post = "postcondition"
)
```

method declaration

method declaration `static` :

```
   { precondition }
   { postcondition }
```

```
@SpecsStatic({
   @SpecStatic(
      pre = "precondition 1",
      post = "postcondition 1"
   ),
   @SpecStatic(
      pre = "precondition 2",
      post = "postcondition 2"
   )
})
```

method declaration

method declaration `static :`

```
{ precondition 1 }
{ postcondition 1 }
andalso
{ precondition 2 }
{ postcondition 2 }
```

Eclipse plug-in

You can write specifications in your java source file. By selecting an option "Specification is included in the source file" in verification configuration, the specification file will be generated from your annotations. This specification file will be used to verify your program.

Command line

You can generate a specification file from your java source file with annotations using command line:

javac
-proc:only
-cp ".;jstar_processing.jar;commons-io-1.4.jar;commons-lang-2.5.jar;annotations.jar"
-d .
-processor com.jstar.eclipse.processing.SpecAnnotationProcessor
MyClass.java

-proc:only
Only annotation processing is done, without any subsequent compilation.

-cp
Specifies the classpath. As well as specifying the classpath to the classes MyClass is referencing to, you need to add the following jar files:

- jstar_processing.jar
  where the processor **com.jstar.eclipse.processing.SpecAnnotationProcessor** lives in.
- commons-io-1.4.jar, commons-lang-2.5.jar
  required libraries for annotation processing.
- annotations.jar
  where the specification annotations live in.

-d
The destination directory for the specification file.
-processor
The name of annotation processor.
MyClass.java
One or more source files with annotations.

6 Example

6.1 com.jstar.eclipse.examples.popl2008

To create a simple Cell/Recell/DCell example, go to
File → **New** → **Example...**.

Select **jStar examples** → **POPL2008 Example** as shown in the picture above.

6.2 New Project

There are basic steps to create and configure your project to be able to verify with jStar:

1. Create a java project.
2. Create some source files.
3. Add annotations.jar to the project Java Build Path **??**.
4. Set jStar root folder in project properties **??**.
5. Write specification in the source file **??**.
6. Add logic and abstraction rules through jStar verification configuration window **??**.
7. Create external class specifications **??**.