Getting started with ANTLR4

Set up the environment

1. **Open up terminal and copy the following commands**

```
wget http://ati.ttu.ee/~hkinks/antlr/antlr.sh
sh antlr.sh
```

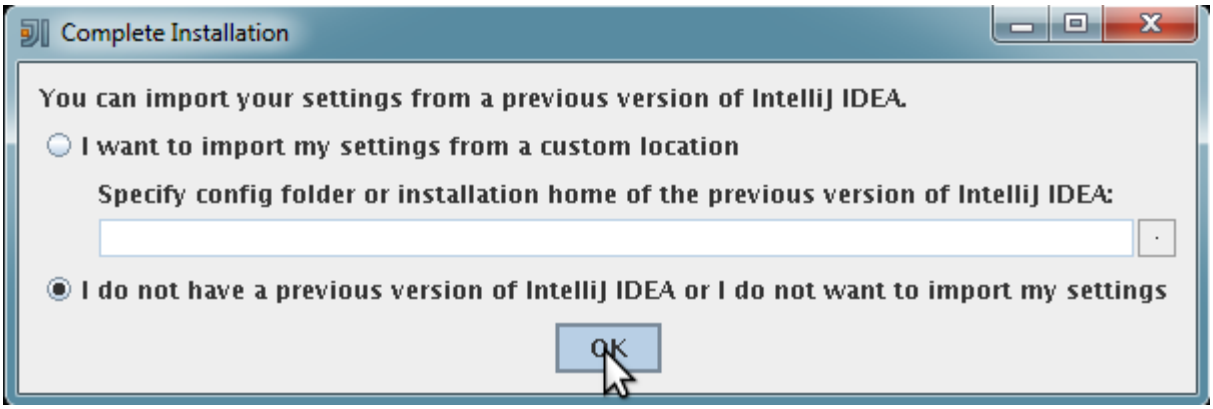
It will download and execute a script which downloads ANTLR4 library, plugin for Intellij IDEA and sets up necessary aliases.

The library and the plugin can be found in 'workspace' directory after running the script.

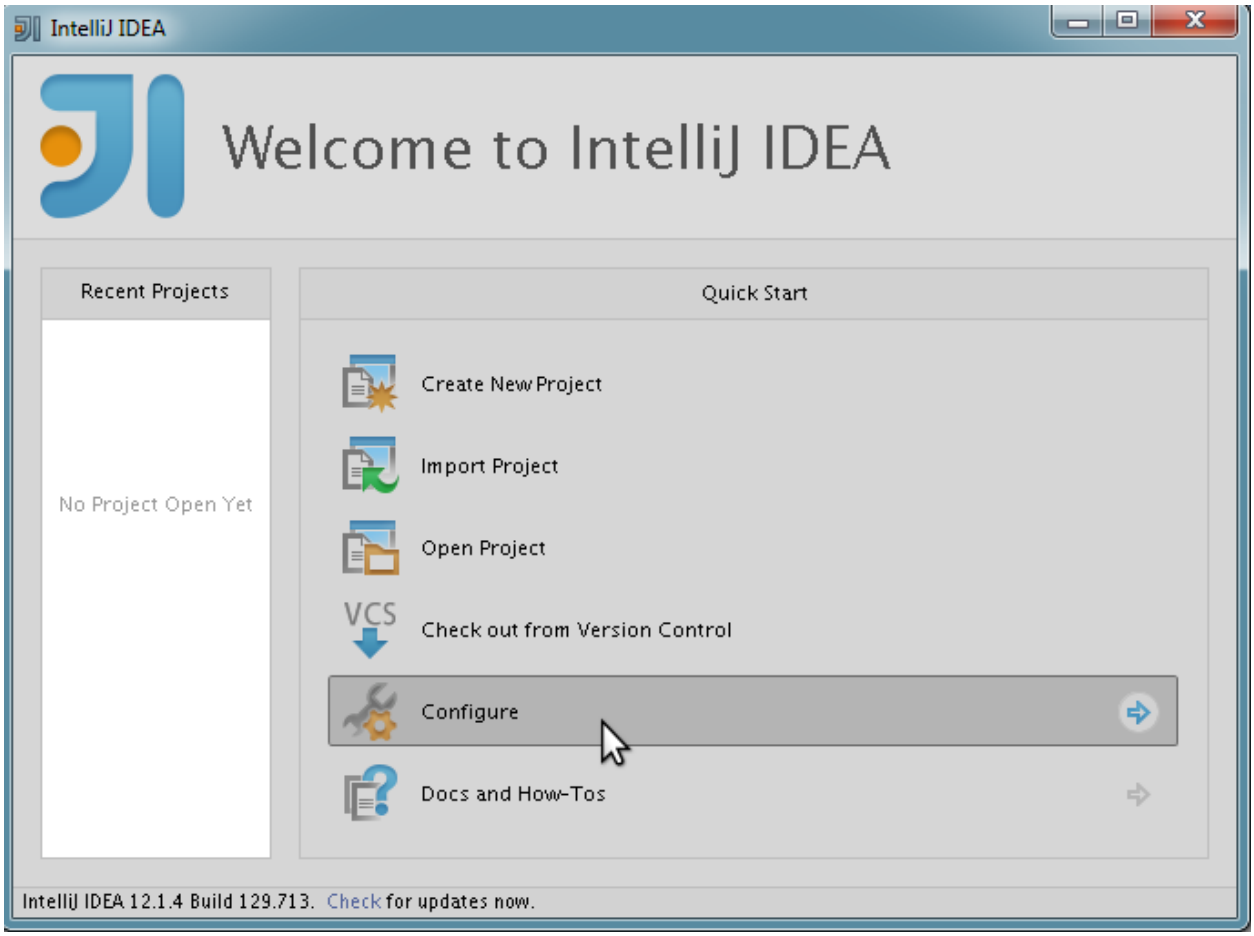
2. **Next open Intellij IDEA where the development will take place**

```
cad
idea &
```

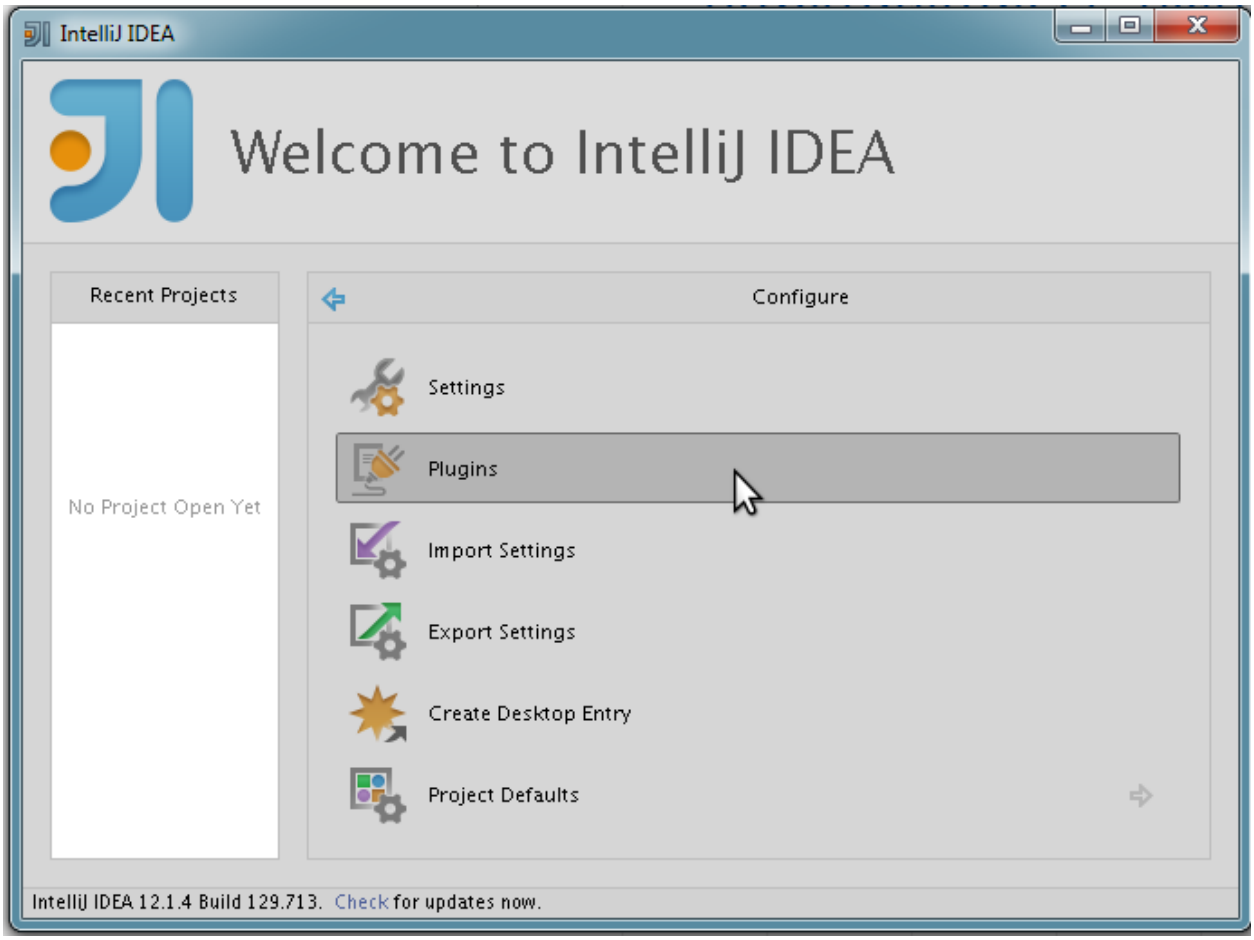
3. **Press OK in the following dialog window**



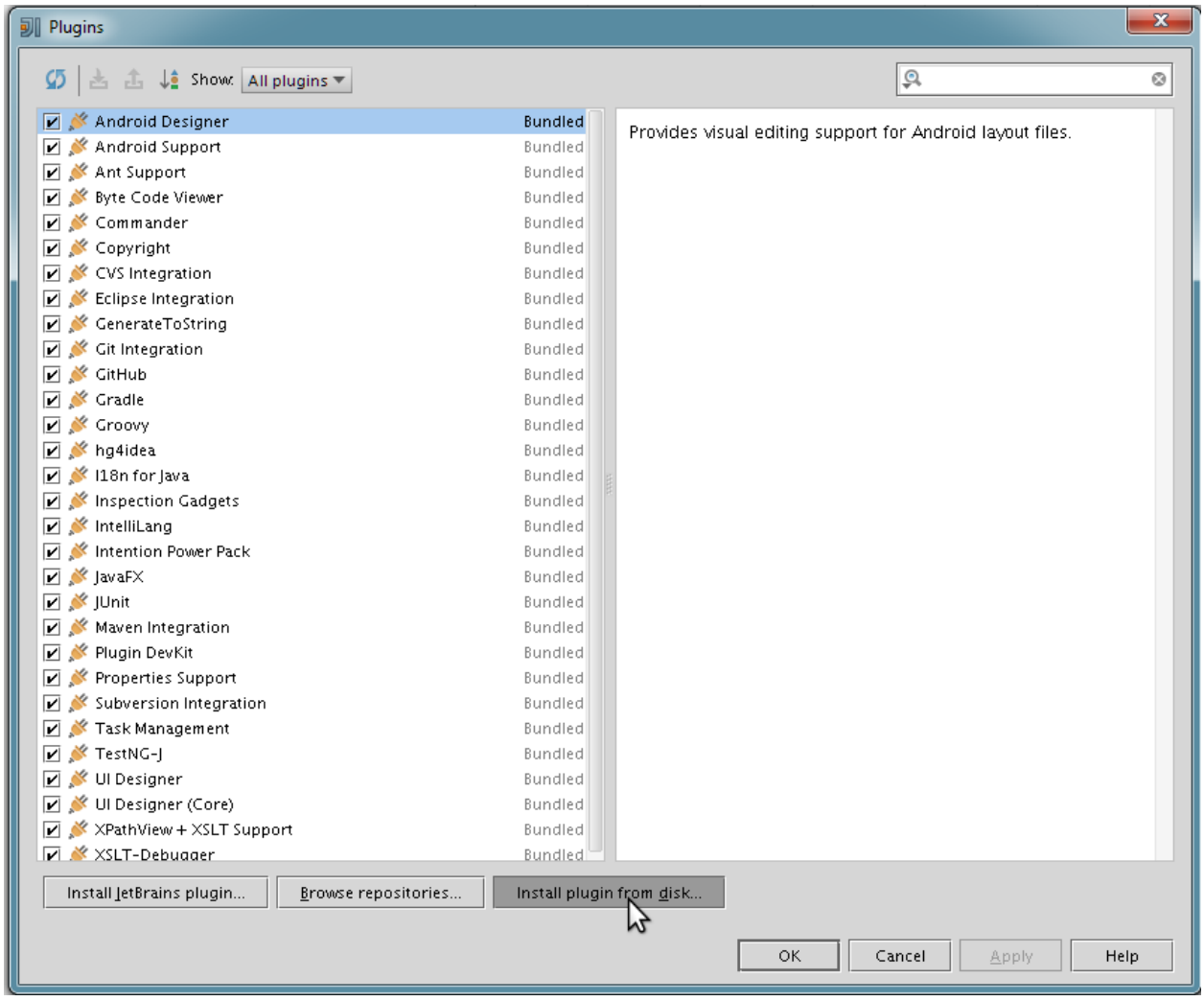
4. **First let's set up the ANTLR plugin to make code generation more convenient. In the Intellij IDEA**



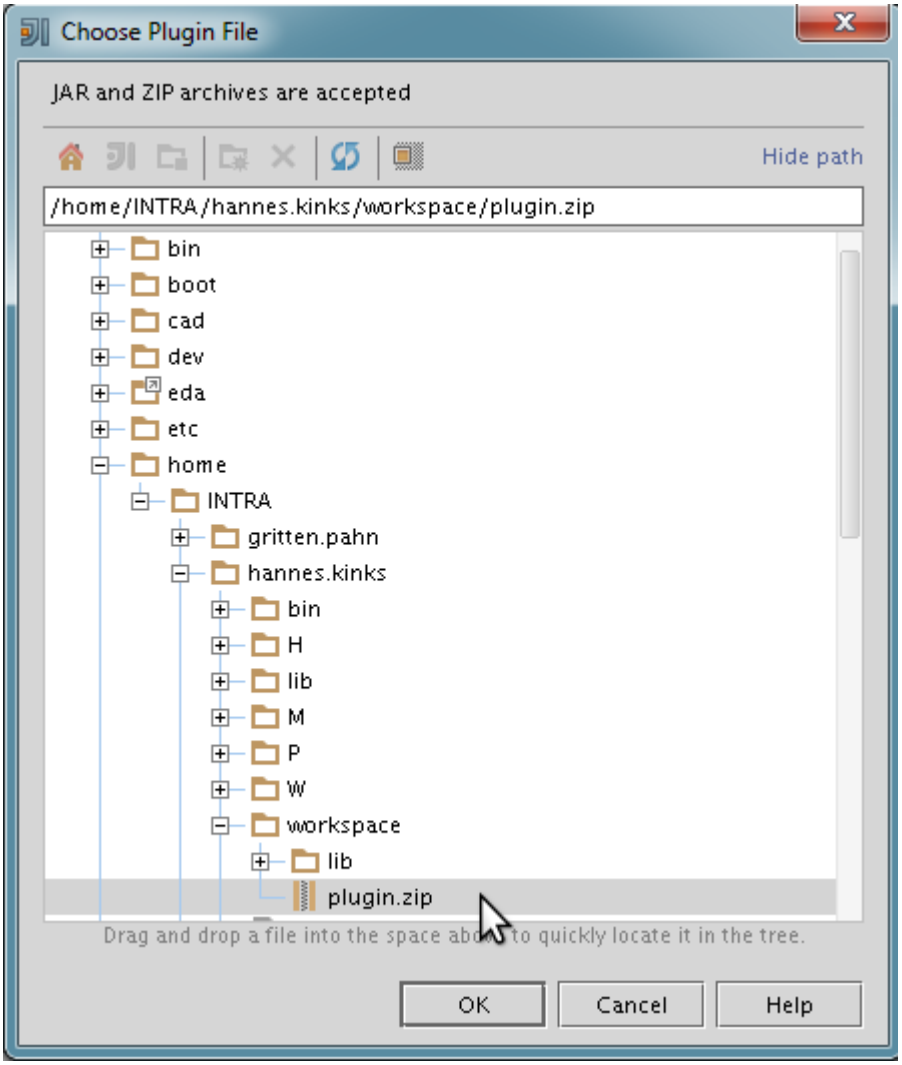
5. Choose Plugins.



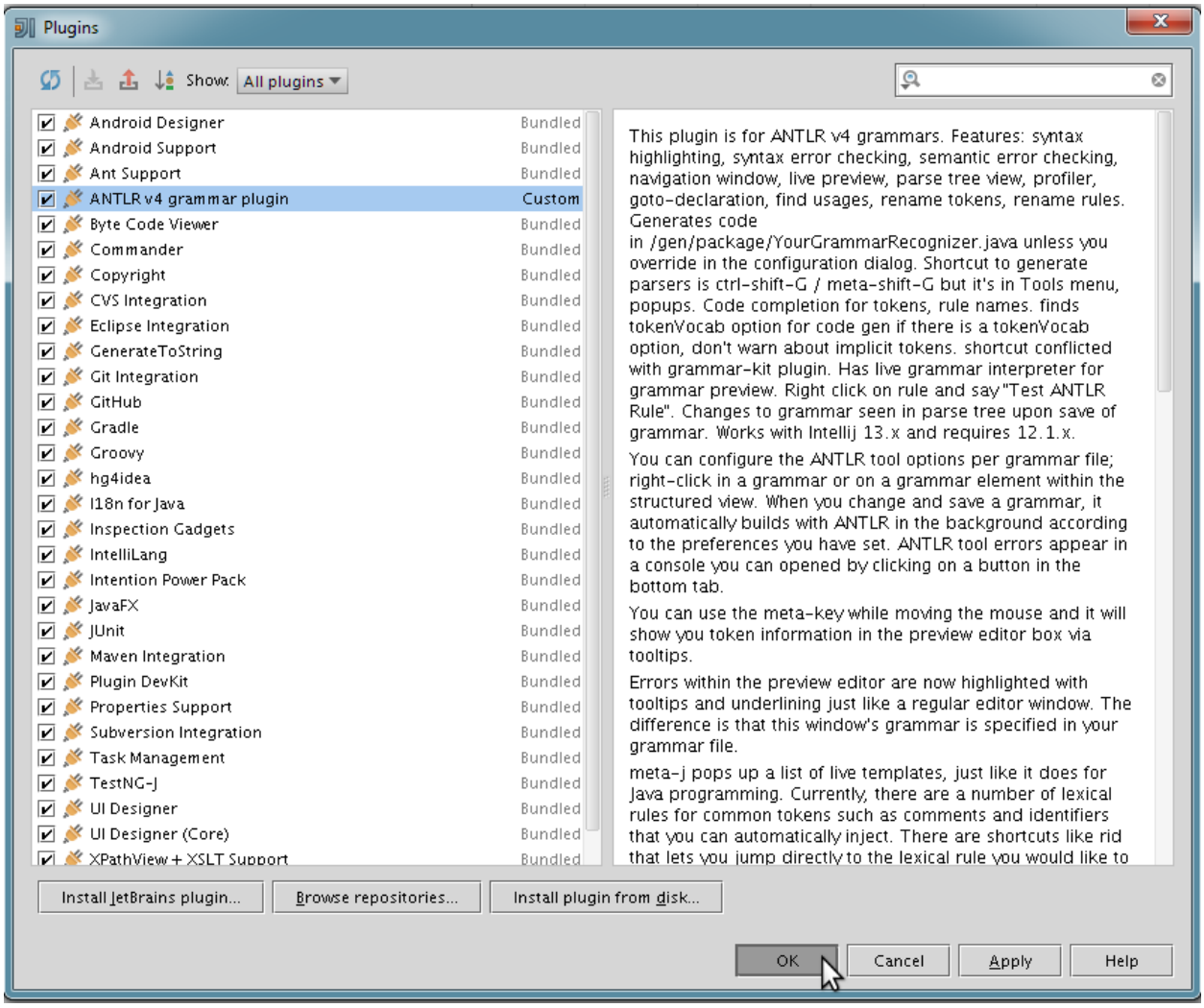
6. **Click Install plugin from disk...**



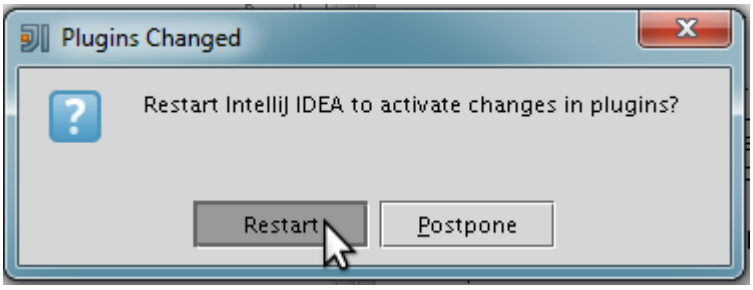
7. **Choose the plugin. When running the bash script in the first section, it should have downloaded it into workspace directory in your home folder: /home/INTRA/<uni-id>/workspace/plugin.zip**



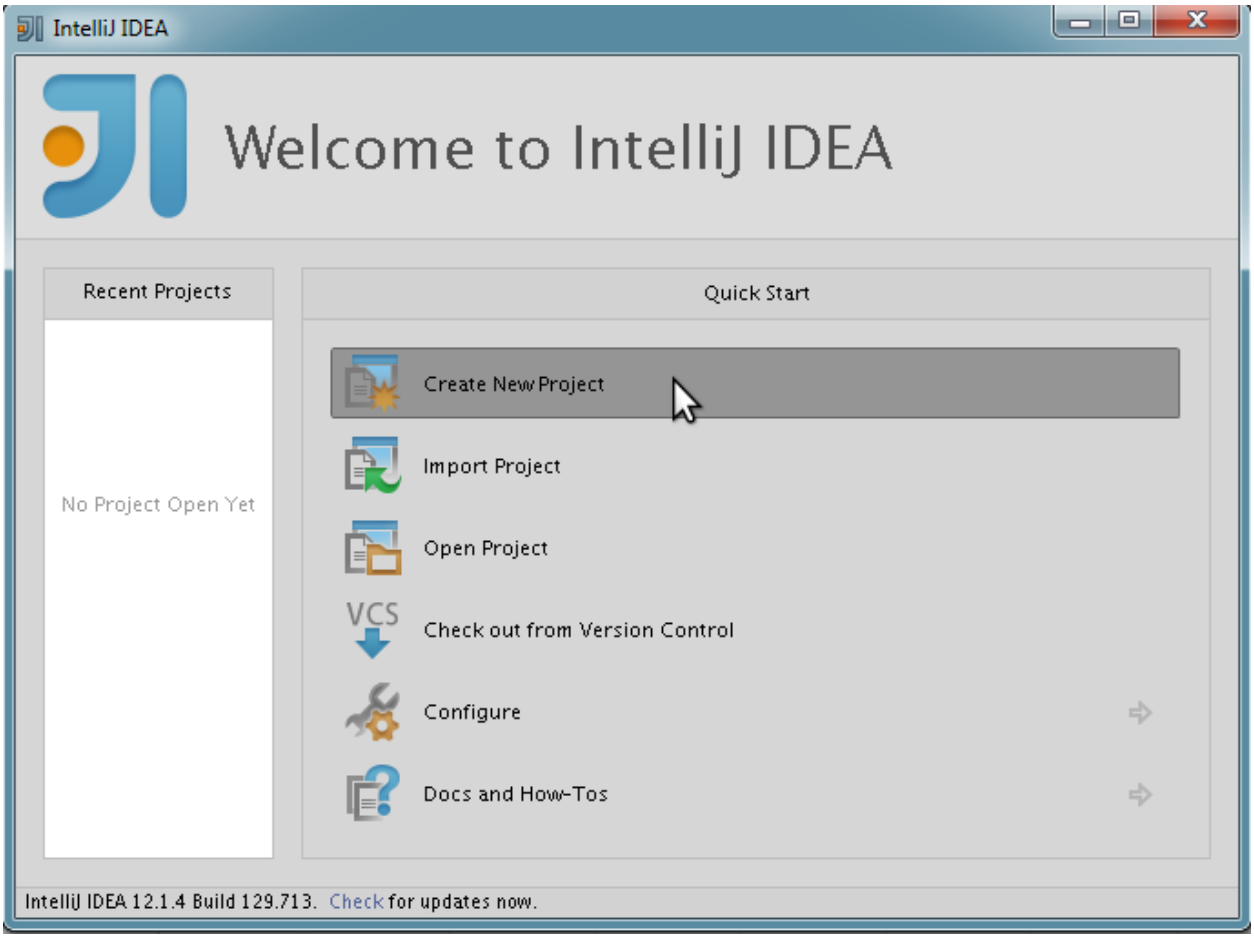
8. **Click OK and the plugin should appear in the plugins list.**



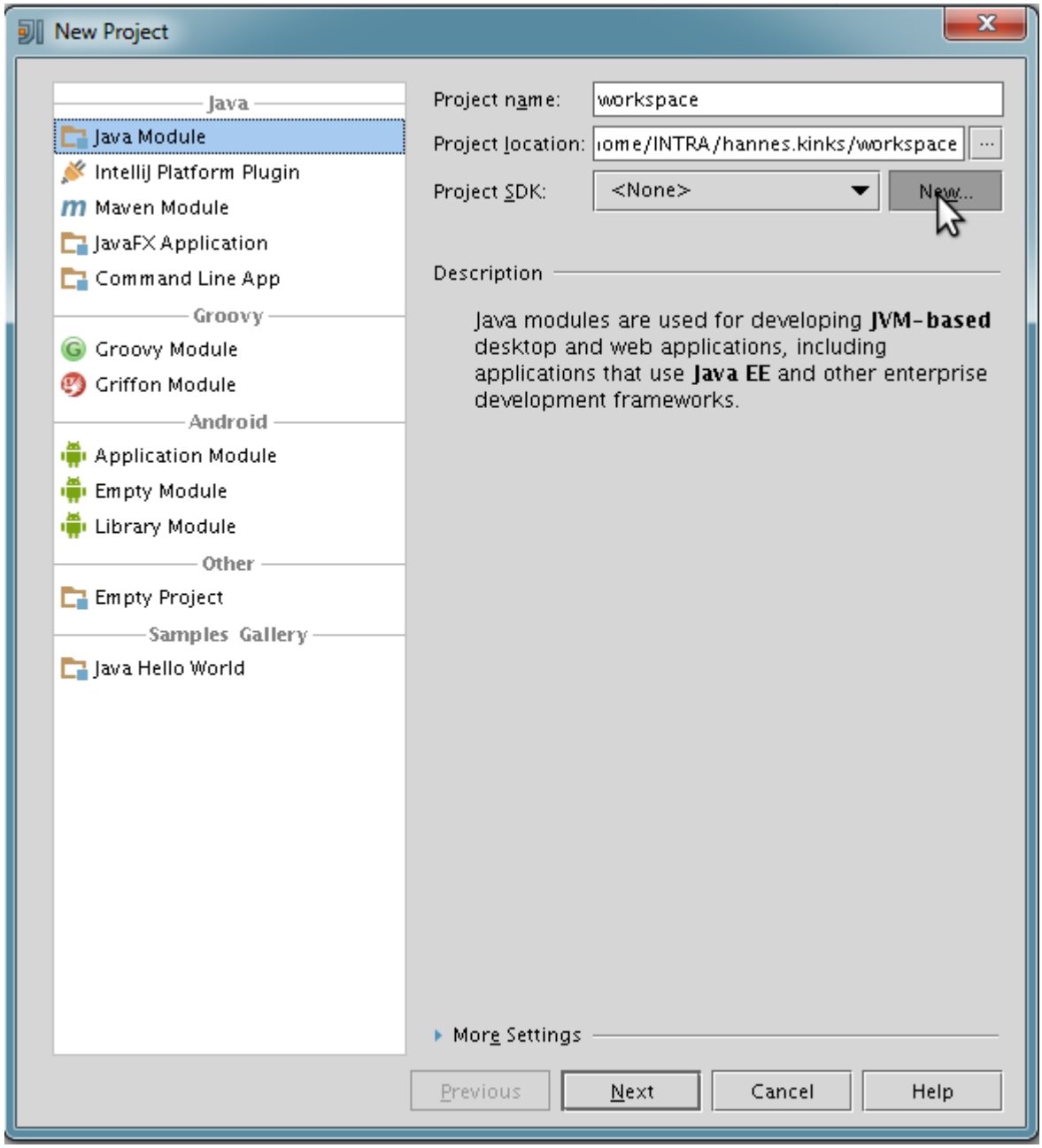
9. **Restart when it requires it.**



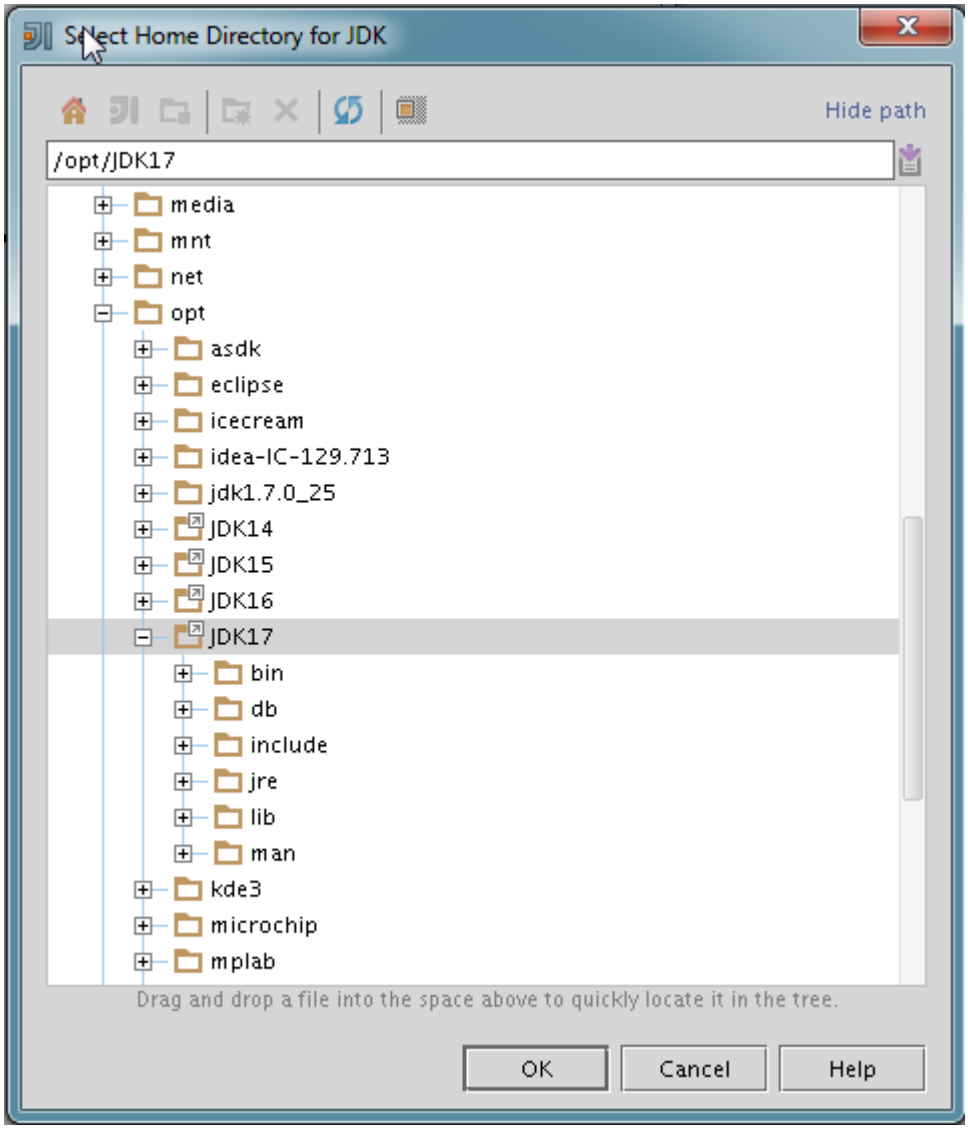
10. Start off with a new project.



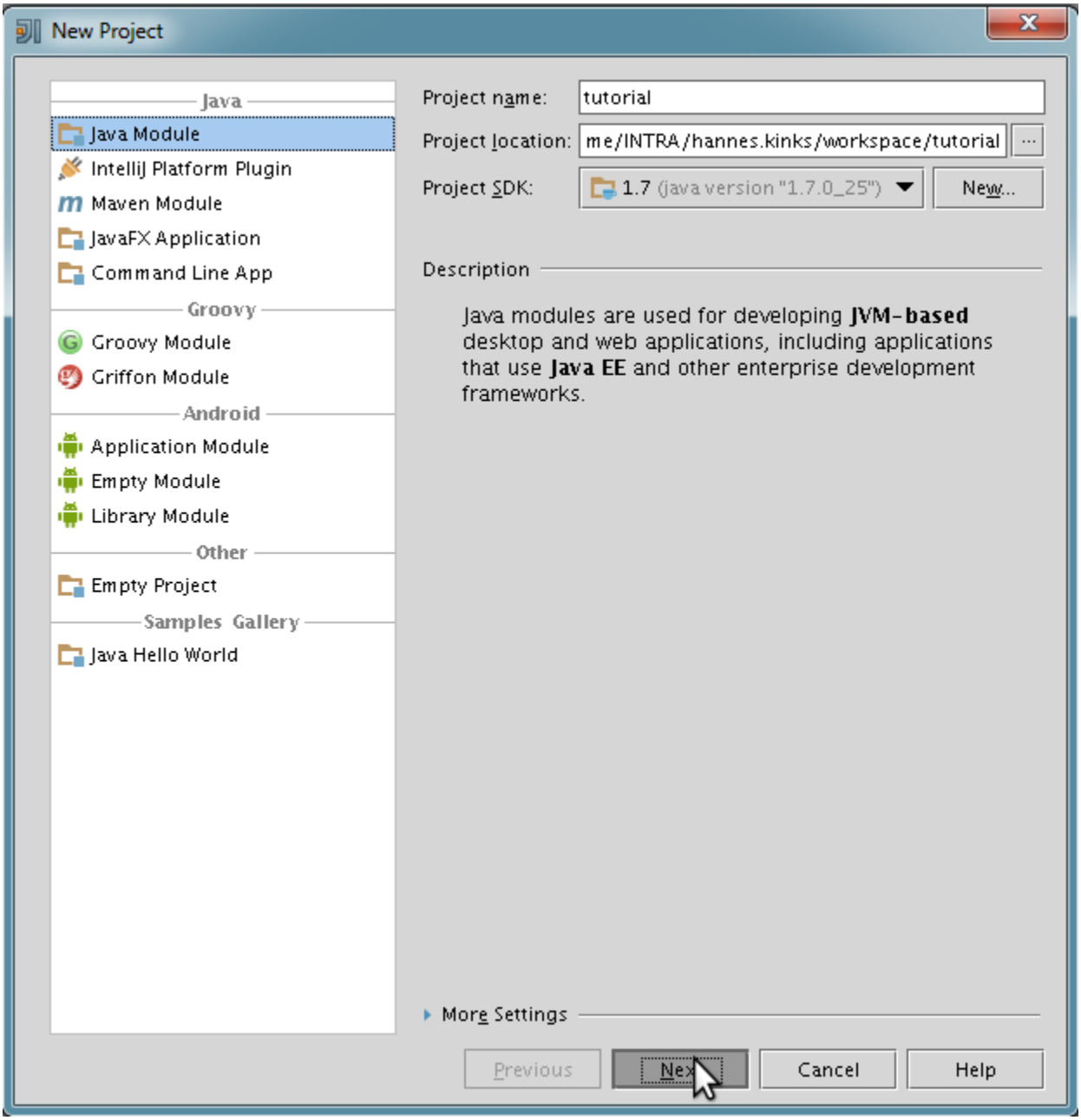
11. **Name your project and set it to be located at the workspace in your home folder. Next specify project SDK.**



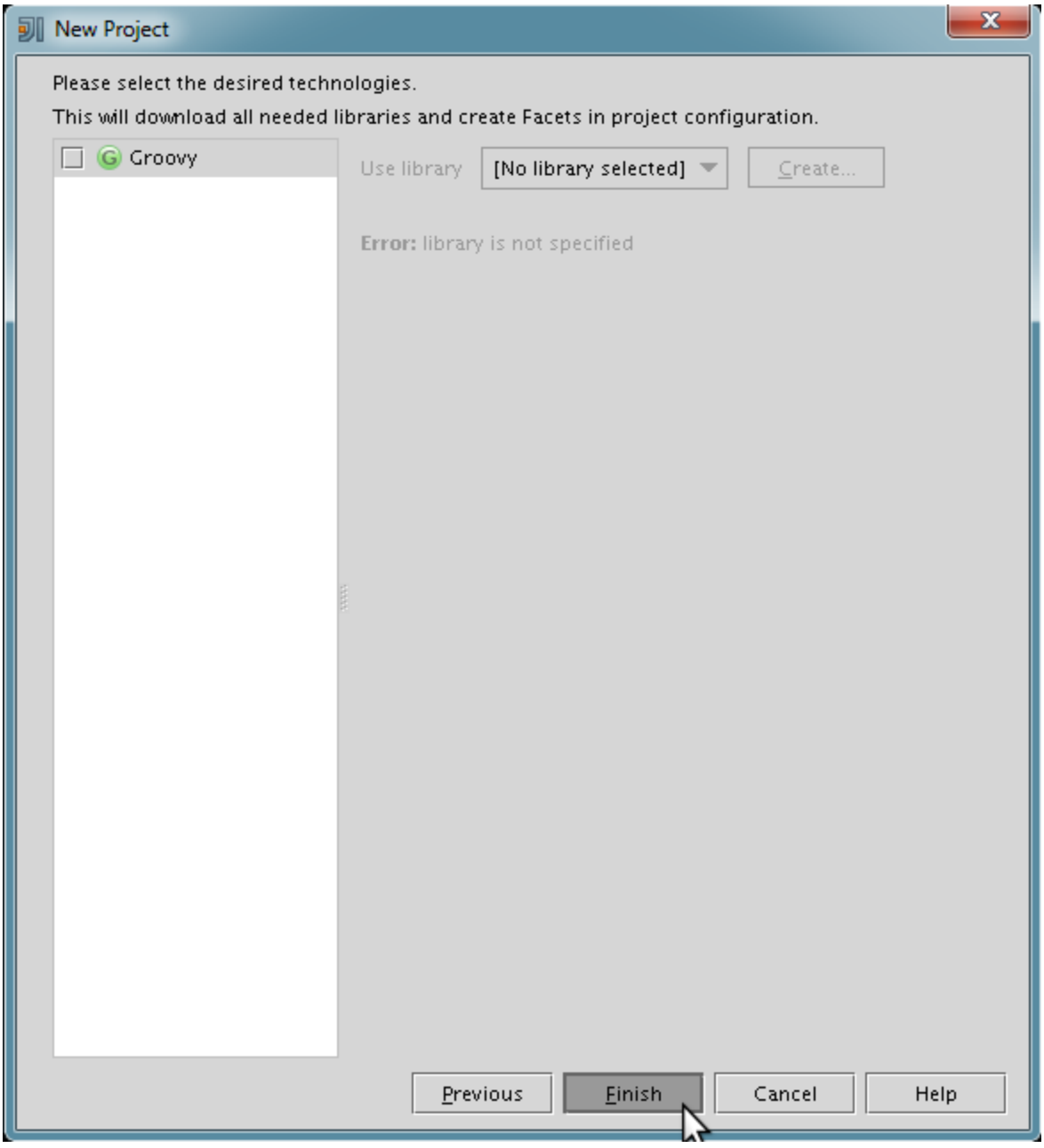
12. Locate to /opt/JDK17 and select it.



13. When everything is set, press Next



14. Finish project creation.



CSV parser tutorial

Now that the environment is set up, we can continue with making a simple CSV parser as a first sample project. The goal would be to have our program accept valid CSV file and parse its contents. What should the program do with the parsed data is up to the application. For an example it could be converted to JSON format and outputted to a file.

Finished project is available in GIT repository http://git.hkinks.com/hkinks/csv-tutorial

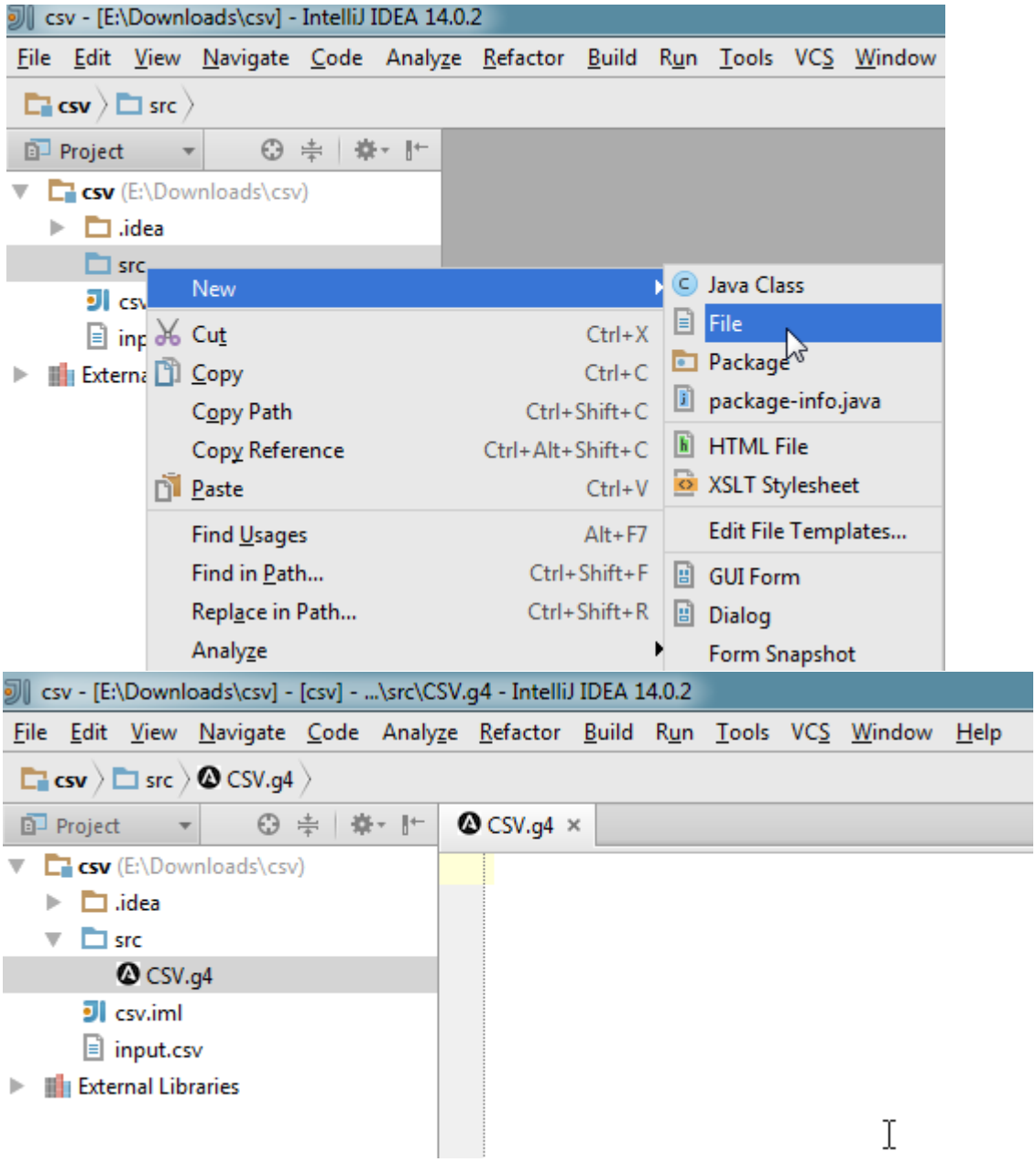
Input

The input should be a regular comma (“,”) separated file. Contents can be made up or a book list example can be downloaded from http://ati.ttu.ee/~hkinks/antlr/input.csv .

Grammar

To get started we should describe the grammar.

1. **Create a new file with .g4 extension.**

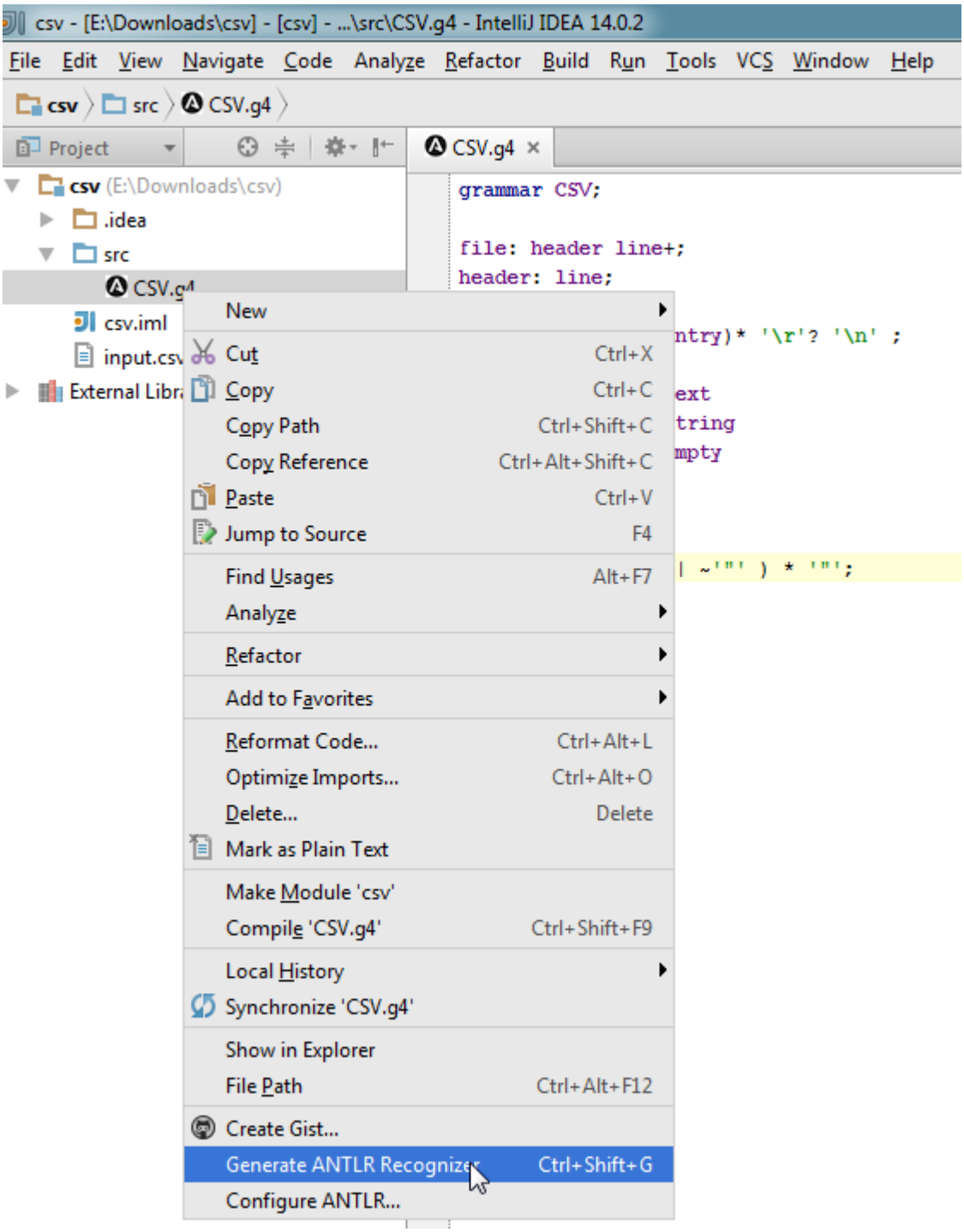


2. **Write grammar. Note that the grammar file name must match with the name specified in the first line. For example: 'CSV.g4' and 'grammar CSV;'**

```
grammar CSV;

file: header line+;
header: line;

line: entry (',' entry)* '\r'? '\n' ;

entry : TEXT    #text
      |         #empty
      ;

TEXT: ~[,\n\r"]+ ;
```

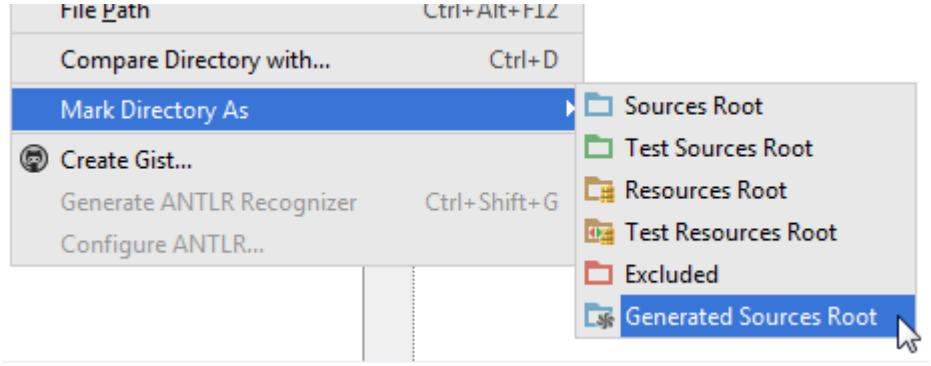
3. **Next step is to let ANTLR generate code. Based on the grammar it will create tokens and parser/lexer classes. Right click on the grammar file and choose Generate ANTLR recognizer...**

***Side note*: By default ANTLR generates code for Listener design pattern. However if you wish to use Visitor pattern instead, you can configure ANTLR to do so by choosing Configure ANTLR... and choosing generate parse tree visitor.**



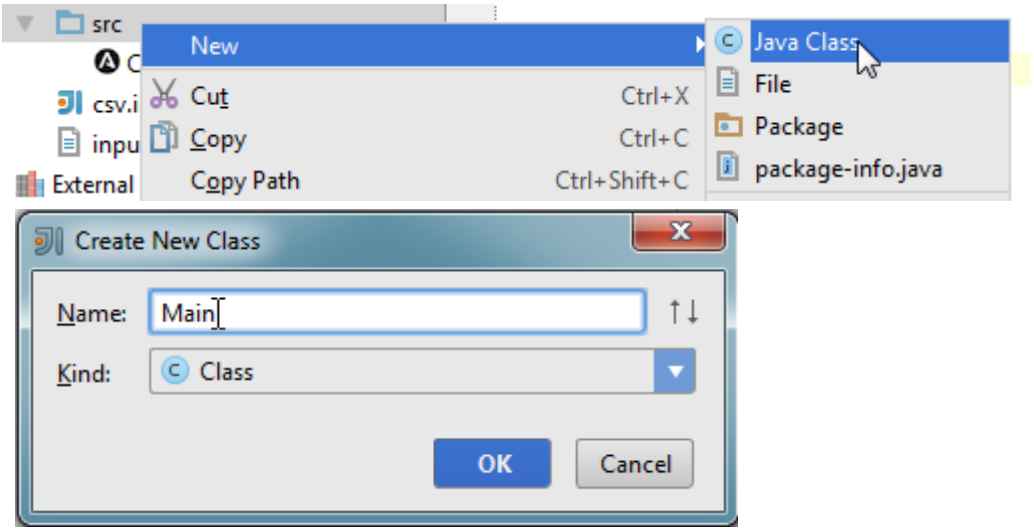
4. **As a result we should get a new folder with the name gen which contains the ANTLR generated files. Intellij IDEA newer versions should recognize the folder by itself that it contains source files.**

However, if the folder does not get marked with a blue icon, you have to do it yourself by right clicking on it, choosing Mark Directory As and choosing either Sources Root or Generated Sources Root.



5. **Make sure that the classes in the generated directory do not have any unresolved dependencies. If they do, Intellij probably does not have ANTLR library properly configured.**

6. **Next we should create a Main class**



7. **We should start off by describing where our input file is, opening it and creating an InputStream. If it fails we can throw an exception saying that the file was not found.**

```
import java.io.FileInputStream;
import java.io.FileNotFoundException;

public class Main {

    public static final String INPUT_CSV = "input.csv";

    public static void main(String[] args) {
        try {
            FileInputStream fileInputStream = new FileInputStream(INPUT_CSV);
```

```
            } catch (FileNotFoundException e) {
                System.err.println("Input file not found.");
                return;
            }
        }
    }
```

8. **The input can now be given to ANTLR lexer, CSVLexer that was generated during the 3rd step where we let ANTLR generate code for us.**

```
CSVLexer lexer;
try {
    lexer = new CSVLexer(new ANTLRInputStream(fileInputStream));
} catch (IOException e) {
    e.printStackTrace();
    return;
}
```

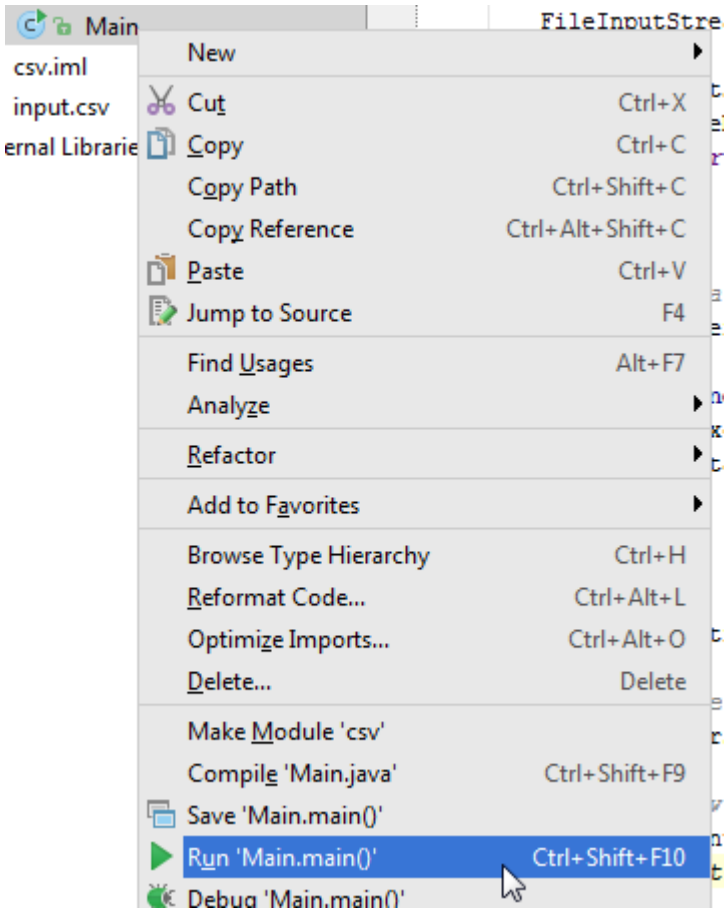
9. **Lexer's result will be a stream of tokens which can be passed to parser.**

```
CommonTokenStream tokens = new CommonTokenStream(lexer);
CSVParser parser = new CSVParser(tokens);
```

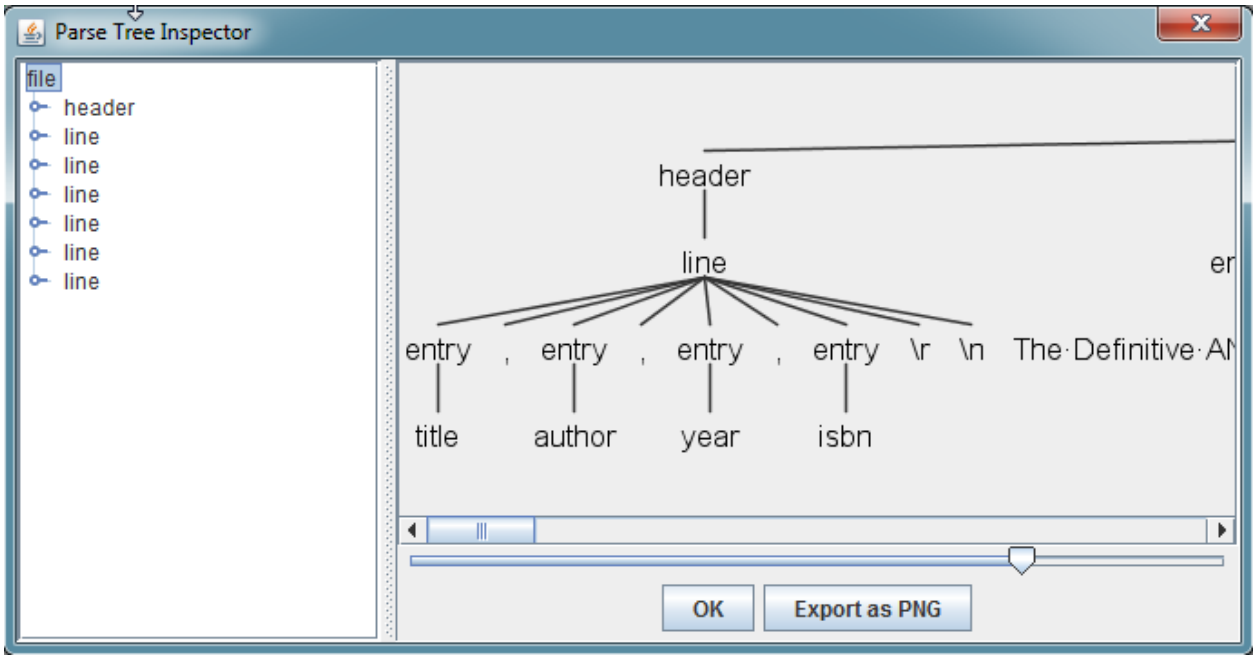
10. **As an intermediate step we can let ANTLR draw us a Parse Tree Diagram, which is good for debugging and making sure the grammar was properly parsed.**

```
ParserRuleContext ruleContext = parser.file();
Trees.inspect(ruleContext, parser);
```

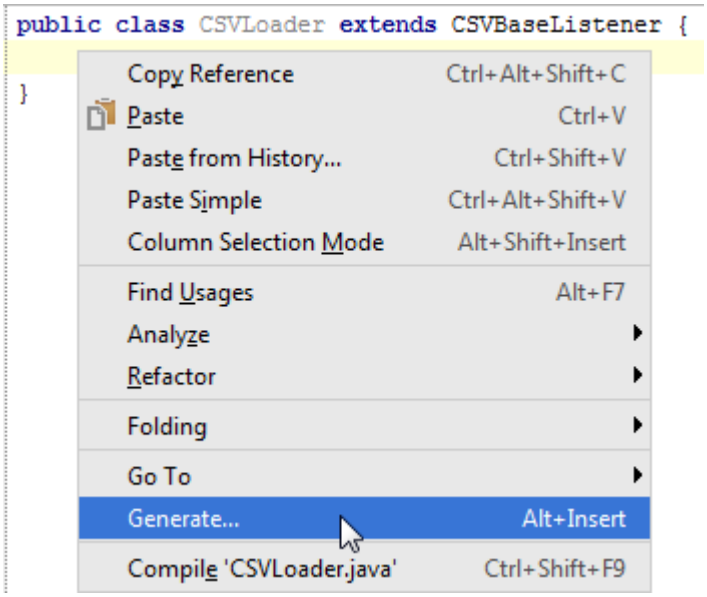
11. Run the code to see the parse tree.



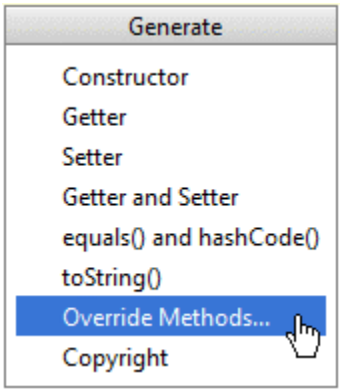
12. You should see something like this:



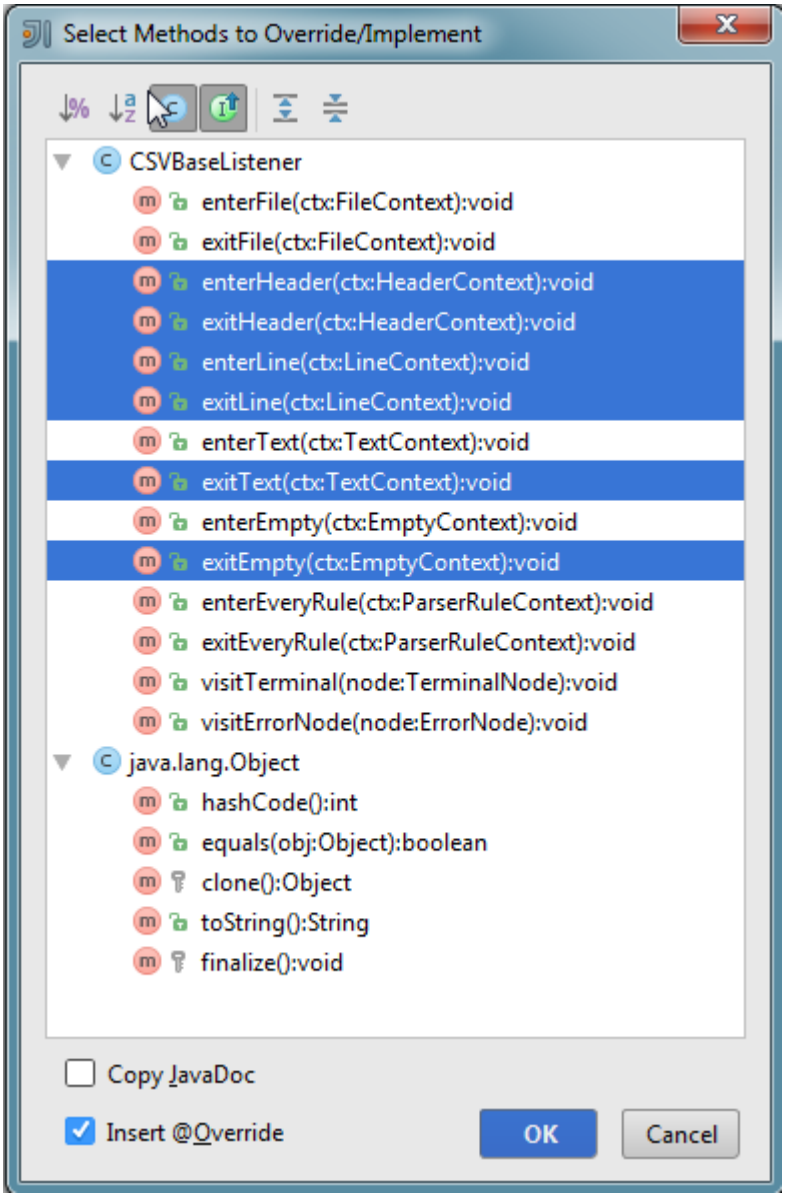
13. **Now if we wish to actually do something with the parsed input, we should implement a listener class that would extend BaseListener class. Create a new class named *CSVLoader* and make it**



14. **By extending the CSVBaseListener we can override methods of interest. Right click in your class, choose generate and from there Override Methods...**



15. **The methods what would interest are for example where the parser enters and exits different contexts specified in the grammar.**



16. **For memorizing the data we can create some Lists that would contain the rows of the csv file. As in the example file we also have a header row, we can add it to a different list and finally associate each entry with its header (we are using map for this).**

```
List<Map<String, String>> rows = new ArrayList<Map<String, String>>();
List<String> header;
List<String> currentRow;
```

17. **Every time we enter a line we create a new row object and when we exit the line, we can add the elements met along the way into it and finally add the row into the list of rows.**

```
@Override
public void enterLine(CSVParser.LineContext ctx) {
    currentRow = new ArrayList<String>();
}

@Override
public void exitLine(CSVParser.LineContext ctx) {
    if (ctx.getParent().getRuleIndex() == CSVParser.RULE_header)
        return;
    Map<String, String> m = new LinkedHashMap<String, String>();
    int i = 0;
    for(String v:currentRow){
        m.put(header.get(i),v);
        i++;
    }
    rows.add(m);
}
```

18. **And in case the line is a header, we add it to the list of headers instead of lines.**

```
@Override
public void exitHeader(CSVParser.HeaderContext ctx) {
    header = new ArrayList<String>();
    header.addAll(currentRow);
}
```

19. **Lines are however not terminal nodes and we should also specify what happens when we go through these. In our case terminal nodes can be either empty or some text.**

```
@Override
public void exitEmpty(CSVParser.EmptyContext ctx) {
    currentRow.add("");
}

@Override
public void exitText(CSVParser.TextContext ctx) {
    currentRow.add(ctx.TEXT().getText());
}
```

20. **Now coming back to our main class we should walk the tree, each time our specified nodes are entered/exited our Loader class will gather the information. The tree drawing code we can comment out for now**

```
ParseTree tree = parser.file();
ParseTreeWalker walker = new ParseTreeWalker();
CSVLoader loader = new CSVLoader();
walker.walk(loader,tree);
```

21. **Finally we can simply print out the contents of the list for now. However, from this step on, we could use this data to convert it to some other format for example.**

```
for(Map<String,String> row:loader.rows)
    System.out.println(row.values());
```

22. The output should look something like this in our case:

```
[The Definitive ANTLR 4 Reference, Terence Parr, 2013, 1934356999]
[The Hobbit, J.R.R. Tolkien, 2002, 0618260307]
[A Game of Thrones (A Song of Ice and Fire), George R.R. Martin, 2005, 0553588486]
[The Hunger Games, Suzanne Collinns, 2008, 0439023483]
[To Kill a Mockingbird, Harper Lee, 2006, 0061120081]
[Animal Farm, George Orwell, 2003, 0452284244]
```