

1-2012

# Deckard - a tree-based, scalable, and accurate code clone detection tool (version 1.2.3)

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## Citation

Lingxiao, J., Misherghi, G., Zhendong, S., & Glondu, S. (2007). DECKARD: Scalable and Accurate Tree-Based Detection of Code Clones. Paper presented at the 29th International Conference on Software Engineering, ICSE 2007. DOI: 10.1109/ICSE.2007.30

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This is a release package of Deckard -- a tree-based, scalable, and accurate code clone detection tool. It is also capable of reporting clone-related bugs.

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* LICENSE
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* Version 1.2.3
* January 22, 2012
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* Installation
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In bash shell or cygwin, run the build script:

```
/path/to/src/main/build.sh
```

For convenience, add "src/main" into \$PATH.

NOTE: Deckard's built-in parser for Java cannot handle Java 1.5 or later features, which means when Deckard processes a Java 1.5 file, it is very likely there will be no vector generated.

NOTE: The compiled executables may not be "executable" (showing "Permission Denied") on Windows Vista/7 due to false alarms of UAC rules (based on file path/hash of a .exe). A simple (but may not be desirable) workaround is to run cygwin shell with elevated privileges before invoking the above scripts. Also, Deckard's performance may be tens of times slower when executed in cygwin than on Linux due to slow I/O operations.

To uninstall, simply

/path/to/src/main/clean.sh

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* Usage
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1. For clone detection (suppose the source code of your application is in /path/to/app/src):

- Specify the location of your source code, say /path/to/app/src.
- Create a "config" file in /path/to/app/, following the sample "config" in samples/ or the template "config-sample" in scripts/clonedetect/. Make sure all paths are valid and the programming language is specified correctly.

- (Optional) create other three directories in /path/to/app/ for storing outputs (see what's in samples/). These directories may be automatically created if specified in 'config'.

- Batch mode run of clone detection (no bug detection by default):

"/path/to/scripts/clonedetect/deckard.sh"

An optional parameter to the script is 'clean', 'clean\_all', or 'overwrite'

- Instead of running 'deckard.sh', you may also run the scripts called in 'deckard.sh' step-by-step by yourself:

- Vector generation: from where "config" is, run

"/path/to/scripts/clonedetect/vdbgen"

An optional parameter to the script is 'clean', 'clean\_all', or 'overwrite'

- Vector clustering (i.e., clone detection): from where "config" is, run

"/path/to/scripts/clonedetect/vertical-param-batch"

An optional parameter to the script is 'clean', 'clean\_all', or 'overwrite'

2. Vector generation for parts of a file:

- Identify the source file name, say /path/to/src/filename.java and the range [s, e] of line numbers you'd like to have a vector generated

- Run "src/main/jvecgen [options] /path/to/src/filename.java --start-line-number s --end-line-number e"

- Run "jvecgen -h" for more options. Note that different vecgen (cvecgen, jvecgen, phpvecgen) should be used for files in different languages.

This vecgen command will generate a vector representing the code between Line 's' and 'e' in the source file, and store the vector in "filename.java.vec" by default.

### 3. Detection of clone-related bugs:

- Invoke 'bugfiltering' on a clone report file with a specified language, e.g.,

- /path/to/scripts/bugdetect/bugfiltering cluster\_result c > bug\_result

- Optionally transform 'bug\_result' to a html file for easier inspection of the reported potentially buggy clones in a web browser:

- /path/to/src/main/out2html bug\_result > bug\_result.html

- See 'deckard.sh' for how to run it in a batch mode (not enabled by default).

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* What are in the package
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```

### 1. Organization

The whole package is organized according to the several components in Deckard:

- Parse tree generation
  - src/include/ : a generic interface for trees
  - src/ptgen/ : ANTLR parser generator
  - src/ptgen/gcc : a grammar for C (GNU C extensions) and its parse tree generator
  - src/ptgen/java : a grammar for Java (<=1.4) and its parse tree generator
  - src/ptgen/php5 : a grammar for php5 and its parse tree generator
- Vector generation
  - src/vgen/treeTra/ : a generic tree traversal framework based on the generic tree interface in src/include, and vector generation based on tree traversal, mostly C++.

- src/vgen/vgrouping/ : code for vector grouping (mix of C, C++, python, bash)
- Vector clustering
  - src/lsh/ : the LSH package and an interface for Deckard to use (src/lsh/source/enumBuckets.cpp).
- Main entrances
  - src/main/ptree.cc : an implementation of the tree interface
  - src/main/main.cc : entrance for vector generation
  - src/main/parseTreeMain.cc : entrance for parse tree dumping, can be useful for inspecting detected clones, bugs, and their related parse trees
  - src/main/bugmain.cc : entrance for bug filtering
  - src/main/out2html.C : entrance for adding html tags into clone/bug reports
- Scripts gluing things together
  - scripts/clonedetect/ : bash and python scripts
    - deckard.sh : batch-mode clone detection
    - vdbgen : batch-mode vector generation
    - vertical-param-batch : batch-mode vector clustering
  - scripts/bugdetect/ : bash and python scripts
  - various auxiliary scripts for simple statistics
- Others
  - README
  - LICENSE

2. Details about the clone/bug detection algorithms can be found in these two papers:

- DECKARD: Scalable and Accurate Tree-based Detection of Code Clones, by Lingxiao JIANG, Ghassan MISHERGHI, Zhendong SU, and Stephane GLONDU. In the proceedings of 29th International Conference on Software Engineering (ICSE '07), Minneapolis, Minnesota, USA, 2007.
- Context-Based Detection of Clone-Related Bugs, by Lingxiao JIANG, Zhendong SU, and Edwin CHIU. In the proceedings of the 6th joint meeting of the European Software Engineering Conference and the ACM SIGSOFT Symposium on the Foundations of Software Engineering (ESEC/FSE'07), Dubrovnik, Croatia, 2007.

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* How to programmably use the vectors and the clone reports?
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```

1. How to get the subtree representing each clone?

Each clone in the reports has a TBID and a TEID, in addition to the file name, and line numbers. The TBID and TEID uniquely identify the IDs of the first token and the last token in the clone from the original file (possibly containing parsing errors). To maintain consistent counting of the IDs, you should leave the work to "yyparse()" and Deckard's TokenCounter for how the IDs are calculated (see TraGenMain::run() for implementation details).

The following are the main steps for getting the subtree for a clone (please refer to "src/vgen/treeTra/token-tree-map.h" for more implementation details):

- Given a line from the clone report file, parse it to get file name, line numbers, TBID, and TEID, etc. C.f. the function:

```
bool parse(char * line, regex_t patterns[], int
dim=ENUM_CLONE_THE_END)
```

- Call the following function (which calls "yyparse()" and a token counter) to get a whole parse tree for the source file and the token IDs for every node:

```
ParseTree* TokenTreeMap::parseFile(const char * filename)
```

- Call the following function to get the smallest tree that contains all tokens between TBID and TEID:

```
Tree* tokenRange2Tree2(std::pair<long, long> tokenrange, ParseTree*
pt)
```

- Then do whatever you'd like with the returned tree. Note that vectors are NOT generated for this tree yet. If vectors are needed, do the following:

```
-- Create a new object of type TraGenMain and call "TraGenMain::run(0,
0)"
(c.f., src/main/main.cc)
```

```
-- Retrieve the vector for the tree:
```

```
TreeVector* tv = TreeAccessor::get_node_vector(Tree*
tree_node_pointer)
```

- If you also want some merged vectors from the child nodes of this tree, that would require calls to TraGenMain::run() with different parameters or adjust the internals of TraGenMain::run(), depending on how you want the vectors to be presented to you. Feel free to improve the vector

generation, both the core and its interface/APIs.

2. How to get the vector for a line or a sequence of lines from a file?

- Option 1: See above: Use "vector generation for parts of a file" with your scripts.

- Option 2: Given the parse tree for a file (produced by TokenTreeMap::parseFile() and yyparse()) and the starting and ending line numbers, do the following:

-- (If not done before,) Call Deckard's vector generator on the parse tree

through TraGenMain::run, same as above. Please refer to src/main/main.cc, TraGenMain::run(int startln, int endl), and VecGenerator::traverse(Tree\* root, Tree\* init).

-- Call the following function (c.f. src/include/ptree.h, src/main/ptree.cc) to return the smallest tree enclosing all elements from these lines:

Tree\* ParseTree::line2Tree(int startln, int endl)

-- Then retrieve the vector (the actual vector generation is done beforehand):

TreeVector\* tv = TreeAccessor::get\_node\_vector(tree\_node\_pointer)

Enjoy and Feedback :=)

@Deckard : Am I a clone?