Static Program Checking - Daikon experiments
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Arithmetic computation

In this exercise, we will use Daikon to generate invariants for a numerical program. Create a file named "Test.java" and declare a class called *Computation* that contains an array of integers (called *elements*) and a size field. The constructor of this class takes a size argument and propagates the array with values from 0..size-1. Now, define an *add* method that takes an integer t, and returns the sum of the first t elements.

```
class Computation {
  int size;
  int[] elements;
  public Computation(int s) {...}
  public int add(int t) {...}
}
```

Next, define a Test class that only contains a *main* method as follows:

```
class Test {
  public static void main(String[] args) {
    Computation c = new Computation(10);
    System.out.println(c.add(5));
  }
}
```

Run Daikon using the following commands to get some invariants about your code. (See the 'Hints' section for setting the classpath variable.)

```
javac -g Test.java
java daikon.Chicory --daikon Test
```

Now, change the last command to the following one in order to print out the invariants in a text file:

```
java daikon.Chicory --daikon Test > Test.txt
```

1. Examine the invariants file (Test.txt) and decide which invariants are useful and which ones are not. Are there any invariants that indicate an insufficient test suite? How can you produce more and better test points?

2. Add two more methods to the computation class: *max* to return the maximum element of the array, and *abs* to compute the absolute value of a given integer. What kinds of invariants does Daikon generate for these methods?

3. Change the confidence limit from the default 0.99 to an extreme 0.01 and see how the invariants change.

4. How can you make Daikon generate loop invariants as well?

Hints

- You can find Daikon's manual webpage at:
  http://plse.cs.washington.edu/daikon/download/doc/daikon.html

- You might need to set your CLASSPATH variable in every shell you open. You may also need to add the current directory "." to your class path, depending on how your class path is set.

  under windows:
  go to control panel – system – advanced – environment variables – edit your class path. The class path should not contain whitespace, or else you get errors.

  under linux (csh shell):

  ```
  setenv CLASSPATH yourpath/daikon/daikon.jar:${CLASSPATH}
  ```

  bash shell:

  ```
  export CLASSPATH=yourpath/daikon/daikon.jar:${CLASSPATH}
  ```

  under MacOS:

  ```
  export CLASSPATH=yourpath/daikon/daikon.jar:$CLASSPATH
  ```

- In order to change the confidence limit, use the following command

  ```
  java daikon.Chicory --daikon --daikon-args="--conf_limit 0.01" Test > Test.txt
  ```