hw3_structural_testing.md

Homework3: Structural Testing

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First, describe what structural testing is and motivate why it is important.

Structural testing is a "white-box testing" method, that is a set of testing techniques that operate on the actual code base of a software system. In contrast to "black-box testing" methods, structural testing works on the actuality of the system rather than ideal behavior.

Motivation: Of the multiple reasons to use strutural testing, some of them are listed below:

1. Tells us what parts of the actual code base haven't received enough testing
2. Runs automatically, and well-integrated with major IDEs

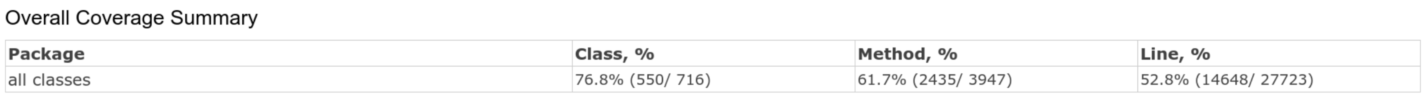
Code coverage for the existing codebase

IntelliJ Code Coverage Report

The full IntelliJ report can be browsed **before** any changes were made here:

Summary of the report

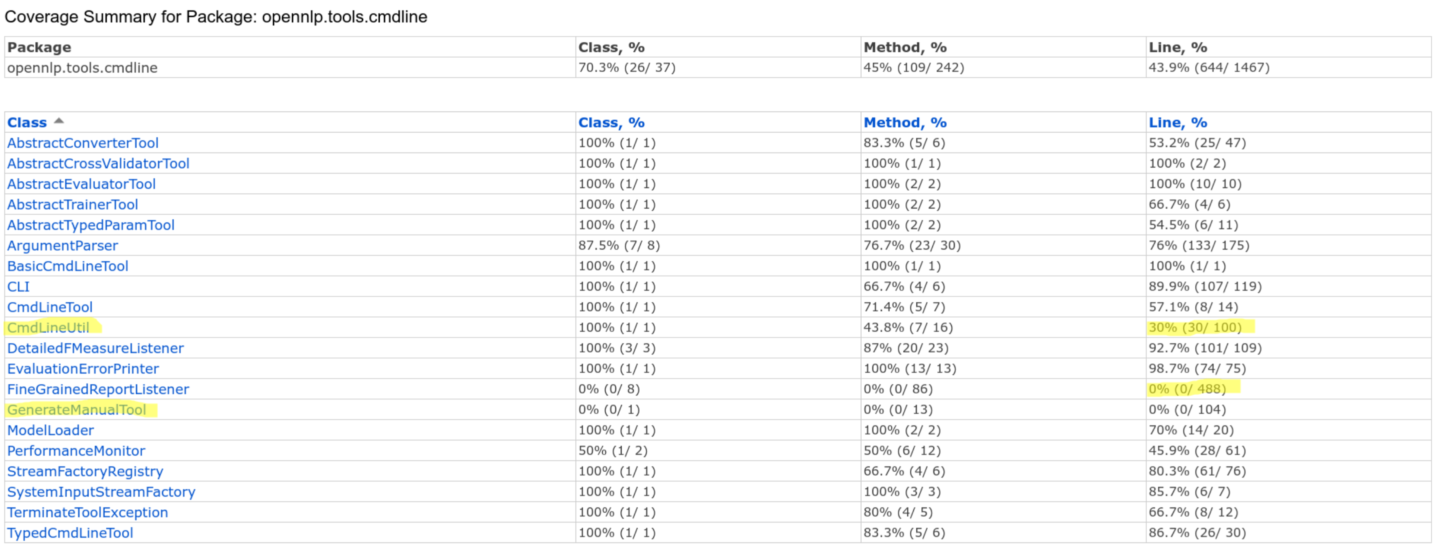
The basic summary is as follows:



Overall Coverage Summary

Package	Class, %	Method, %	Line, %
all classes	76.8% (550/ 716)	61.7% (2435/ 3947)	52.8% (14648/ 27723)

Documenting some uncovered parts of the test suite



Coverage Summary for Package: opennlp.tools.cmdline

Package	Class, %	Method, %	Line, %
opennlp.tools.cmdline	70.3% (26/ 37)	45% (109/ 242)	43.9% (644/ 1467)

Class ▲	Class, %	Method, %	Line, %
AbstractConverterTool	100% (1/ 1)	83.3% (5/ 6)	53.2% (25/ 47)
AbstractCrossValidatorTool	100% (1/ 1)	100% (1/ 1)	100% (2/ 2)
AbstractEvaluatorTool	100% (1/ 1)	100% (2/ 2)	100% (10/ 10)
AbstractTrainerTool	100% (1/ 1)	100% (2/ 2)	66.7% (4/ 6)
AbstractTypedParamTool	100% (1/ 1)	100% (2/ 2)	54.5% (6/ 11)
ArgumentParser	87.5% (7/ 8)	76.7% (23/ 30)	76% (133/ 175)
BasicCmdLineTool	100% (1/ 1)	100% (1/ 1)	100% (1/ 1)
CLI	100% (1/ 1)	66.7% (4/ 6)	89.9% (107/ 119)
CmdLineTool	100% (1/ 1)	71.4% (5/ 7)	57.1% (8/ 14)
CmdLineUtil	100% (1/ 1)	43.8% (7/ 16)	30% (30/ 100)
DetailedFMeasureListener	100% (3/ 3)	87% (20/ 23)	92.7% (101/ 109)
EvaluationErrorPrinter	100% (1/ 1)	100% (13/ 13)	98.7% (74/ 75)
FineGrainedReportListener	0% (0/ 8)	0% (0/ 86)	0% (0/ 488)
GenerateManualTool	0% (0/ 1)	0% (0/ 13)	0% (0/ 104)
ModelLoader	100% (1/ 1)	100% (2/ 2)	70% (14/ 20)
PerformanceMonitor	50% (1/ 2)	50% (6/ 12)	45.9% (28/ 61)
StreamFactoryRegistry	100% (1/ 1)	66.7% (4/ 6)	80.3% (61/ 76)
SystemInputStreamFactory	100% (1/ 1)	100% (3/ 3)	85.7% (6/ 7)
TerminateToolException	100% (1/ 1)	80% (4/ 5)	66.7% (8/ 12)
TypedCmdLineTool	100% (1/ 1)	83.3% (5/ 6)	86.7% (26/ 30)

The first part that I focused on was the `CmdLineUtil` module. This is a set of procedures for ensuring safety and sanity of the commandline handling mechanism. The line coverage is a only 30% (30/100).

Another part of the system that is totally not covered is the `GenerateManualTool` which has automatic mechanisms for collecting and generating an XML report on the CLI interface.

Increasing code-coverage

I created a new set of tests (15+) for testing various aspects of commandline utilities:

- Covering various error cases when dealing with files/folders
- Sanity checking the various commandline parameters
- Dealing with Training Parameters and Write Models

```
package opennlp.tools.cmdline;


import opennlp.tools.chunker.ChunkerFactory;
import opennlp.tools.chunker.ChunkerME;
import opennlp.tools.chunker.ChunkerModel;
import opennlp.tools.cmdline.chunker.ChunkerTrainerTool;
import opennlp.tools.util.TrainingParameters;
import opennlp.tools.util.model.ModelUtil;
import org.junit.Assert;
import org.junit.Test;

import java.io.BufferedWriter;
import java.io.File;
import java.io.FileWriter;
import java.io.IOException;

public class CmdLineUtilTest {
    @Test(expected = TerminateToolException.class)
    public void testCIFDoesntExist(){
        File existingFile = new File("sampledata2");
        CmdLineUtil.checkInputFile("sampledata2", existingFile);
    }

    @Test
    public void testCIFValidFile(){
        File existingFile = new File("sampledata");
        CmdLineUtil.checkInputFile("sampledata", existingFile);
    }

    @Test(expected = TerminateToolException.class)
    public void testCIFIsADirectory(){
        File directory = new File("src");
        CmdLineUtil.checkInputFile("src", directory);
    }

    @Test(expected =  TerminateToolException.class)
    public void testCIFNoPermissions(){
        File fstab = new File("unreadablefile");
        CmdLineUtil.checkInputFile("unreadablefile", fstab);
    }

    @Test(expected = TerminateToolException.class)
    public void testOutputDir(){
        File directory = new File("src");
        CmdLineUtil.checkOutputFile("src", directory);
    }

    @Test(expected = TerminateToolException.class)
    public void testOutputNoPermission(){
        File fstab = new File("unreadablefile");
        CmdLineUtil.checkOutputFile("unreadablefile", fstab);
    }

    @Test(expected = TerminateToolException.class)
    public void testOutputInvalidParent(){
        File fstab = new File("nonexistentplace/newfile");
        CmdLineUtil.checkOutputFile("nonexistent", fstab);
    }

    @Test(expected = TerminateToolException.class)
    public void testopenInFile(){
        File invalidfile = new File("sampledata2");
        CmdLineUtil.openInFile(invalidfile);
    }

    @Test(expected = TerminateToolException.class)
```

```
public void testcreateInputStreamFactory(){
    File invalidfile = new File("sampledata2");
    CmdLineUtil.openInFile(invalidfile);
}


@Test
public void testGetParameterIndex() {
    String param="-name";
    String[] args = {"-name", "b", "c"};
    Assert.assertEquals(0, CmdLineUtil.getParameterIndex("-name", args));

}

@Test
public void testGetParameterIndex2() {
    String param="-name";
    String[] args = {"name", "b", "c"};
    Assert.assertEquals(-1, CmdLineUtil.getParameterIndex("-name", args));

}

@Test
public void testGetParameter1() {
    String param="-name";
    String[] args = {"-name", "b", "c"};
    Assert.assertEquals("b", CmdLineUtil.getParameter(param, args));
}

@Test
public void testGetParameter2(){
    String param="-noname";
    String[] args = {"-name", "b", "c"};
    Assert.assertEquals(null, CmdLineUtil.getParameter(param, args));
}

@Test
public void testGetIntParameter(){
    String param="-number";
    String[] args = {"-name", "abc"};
    Assert.assertEquals(null, CmdLineUtil.getIntParameter(param, args));
}

@Test
public void testHandleDoubleParameter(){
    String param="-number";
    String[] args = {"-name", "abc"};
    Assert.assertEquals(null, CmdLineUtil.getDoubleParameter(param, args));
}

@Test(expected = TerminateToolException.class)
public void testCheckLanugageCode(){
    String randomlang = "random101";
    CmdLineUtil.checkLanguageCode(randomlang);
}

@Test
public void testContainsParam(){
    String contains = "-invalid";
    String[] args = {"-name", "a", "-ab", "b", "-c"};
    Assert.assertEquals(false, CmdLineUtil.containsParam(contains, args));
}

@Test(expected = TerminateToolException.class)
public void testhandleStdinIoError(){
    try {
        BufferedWriter bw = new BufferedWriter(new FileWriter("/"));
    } catch (IOException e) {
        CmdLineUtil.handleStdinIoError(e);
    }
}

@Test(expected = TerminateToolException.class)
public void testhandleCreateObjectStreamError(){
    try {
```

```
                BufferedWriter bw = new BufferedWriter(new FileWriter("/"));
            } catch (IOException e) {
                CmdLineUtil.handleCreateObjectStreamError(e);
            }
        }

        @Test
        public void testloadTrainingParameters(){
            CmdLineUtil.loadTrainingParameters("sampledata", true);
        }

        @Test(expected = TerminateToolException.class)
        public void testWriteModel(){

            ChunkerTrainerTool c = new ChunkerTrainerTool();
            String[] args = {};
            c.run(null, new String[]{"ParserTrainer", "-headRules", "headRulesFile", "-parserType",
                    "TREEINSERT", "-lang", "English", "-model", "", "-data", "sampledata"});
        }
    }
```

The manual generation functionality is invoked with a valid xml file and ensured to be existing:

package opennlp.tools.cmdline;

import org.junit.Test;

public class testGenerateManualTool {

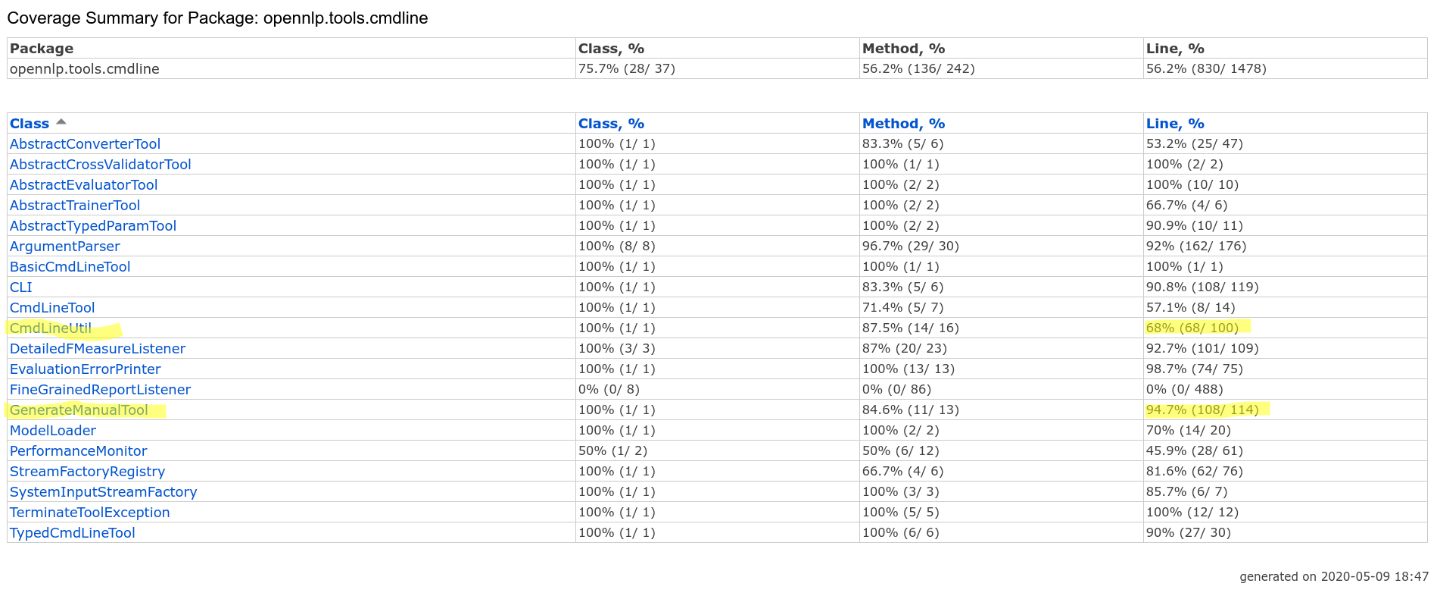
```
  @Test
  public void testManualTool() {
      String[] args = {"output.xml"};
      try {
          GenerateManualTool.main(args);
      } catch (java.io.FileNotFoundException e) {
          System.out.print("Output file not found");
      }
  }
```

}

The manual generation mechanism is tested like so:

```
  package opennlp.tools.cmdline;

  import org.junit.Assert;
  import org.junit.Test;

  import java.io.File;

  public class testGenerateManualTool {

      @Test
      public void testManualTool() {
          String[] args = {"output.xml"};
          try {
              GenerateManualTool.main(args);
          } catch (java.io.FileNotFoundException e) {
              System.out.print("Output file not found");
          }
          File f = new File("output.xml");
          double bytes = f.length();

          Assert.assertTrue("File is populated", bytes > 0);
      }
  }
```

Result



Coverage Summary for Package: opennlp.tools.cmdline

Package	Class, %	Method, %	Line, %
opennlp.tools.cmdline	75.7% (28/ 37)	56.2% (136/ 242)	56.2% (830/ 1478)

Class	Class, %	Method, %	Line, %
AbstractConverterTool	100% (1/ 1)	83.3% (5/ 6)	53.2% (25/ 47)
AbstractCrossValidatorTool	100% (1/ 1)	100% (1/ 1)	100% (2/ 2)
AbstractEvaluatorTool	100% (1/ 1)	100% (2/ 2)	100% (10/ 10)
AbstractTrainerTool	100% (1/ 1)	100% (2/ 2)	66.7% (4/ 6)
AbstractTypedParamTool	100% (1/ 1)	100% (2/ 2)	90.9% (10/ 11)
ArgumentParser	100% (8/ 8)	96.7% (29/ 30)	92% (162/ 176)
BasicCmdLineTool	100% (1/ 1)	100% (1/ 1)	100% (1/ 1)
CLI	100% (1/ 1)	83.3% (5/ 6)	90.8% (108/ 119)
CmdLineTool	100% (1/ 1)	71.4% (5/ 7)	57.1% (8/ 14)
CmdLineUtil	100% (1/ 1)	87.5% (14/ 16)	68% (68/ 100)
DetailedFMeasureListener	100% (3/ 3)	87% (20/ 23)	92.7% (101/ 109)
EvaluationErrorPrinter	100% (1/ 1)	100% (13/ 13)	98.7% (74/ 75)
FineGrainedReportListener	0% (0/ 8)	0% (0/ 86)	0% (0/ 488)
GenerateManualTool	100% (1/ 1)	84.6% (11/ 13)	94.7% (108/ 114)
ModelLoader	100% (1/ 1)	100% (2/ 2)	70% (14/ 20)
PerformanceMonitor	50% (1/ 2)	50% (6/ 12)	45.9% (28/ 61)
StreamFactoryRegistry	100% (1/ 1)	66.7% (4/ 6)	81.6% (62/ 76)
SystemInputStreamFactory	100% (1/ 1)	100% (3/ 3)	85.7% (6/ 7)
TerminateToolException	100% (1/ 1)	100% (5/ 5)	100% (12/ 12)
TypedCmdLineTool	100% (1/ 1)	100% (6/ 6)	90% (27/ 30)

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- CmdlineUtil: 30/100 -> 68/100 -> +38 lines
- GenerateManualTool: 0/114 -> 108/114 -> +108 lines

In total 146 new lines were added to code coverage