Test Log for 1X1 Streamlined Domain Testing

Document ID: COMP3403A1P2_DT

Test Item: IUT of a new air pollution index developed by EPD

Testing Environment: Eclipse IDE for Java Developers (4.5.2), Mac OS X Yosemite (10.10.5)

Date of Testing: April 4, 2016

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Modification from part 1 version: some output and log sentences were updated to show more details about certain test, including inputs and outputs. Testing procedures are unchanged.

Time of Testing: 3s

Procedure Results:

output.txt:

```
========== Streamlined Domain Test Result ==========
Test 1 Pass! RSP=100.1 SO2=1.0 NO2=0.5 O3=0.5 - IUT = 1623, Oracle = 1623, V1
Test 2 Fail! RSP=300.0 SO2=1.0 NO2=0.5 O3=0.5 - IUT = 5000, Oracle = 4861, V1
Test 3 Fail! RSP=200.0 SO2=1.0 NO2=1.499 O3=0.5 - IUT = 3254, Oracle = 3244, V1
Test 4 Pass! RSP=200.0 SO2=1.0 NO2=0.5 O3=1.499 - IUT = 3241, Oracle = 3241, V1
Test 5 Pass! RSP=200.0 SO2=0.501 NO2=0.5 O3=0.5 - IUT = 3241, Oracle = 3241, V1
Test 6 Pass! RSP=200.0 SO2=2.999 NO2=0.5 O3=0.5 - IUT = 3241, Oracle = 3241, V1
Test 7 Pass! RSP=100.1 SO2=0.2 NO2=0.5 O3=0.5 - IUT = 1501, Oracle = 1501, V2
Test 8 Fail! RSP=300.0 SO2=0.2 NO2=0.5 O3=0.5 - IUT = 4950, Oracle = 4500, V2
Test 9 Pass! RSP=200.0 SO2=0.2 NO2=0.0 O3=0.5 - IUT = 3000, Oracle = 3000, V2
Test 10 Pass! RSP=200.0 SO2=0.2 NO2=0.5 O3=0.0 - IUT = 3000, Oracle = 3000, V2
Test 11 Pass! RSP=200.0 SO2=0.0 NO2=0.5 O3=0.5 - IUT = 3000, Oracle = 3000, V2
Test 12 Pass! RSP=200.0 SO2=0.5 NO2=0.5 O3=0.5 - IUT = 3000, Oracle = 3000, V2
Test 13 Pass! RSP=0.0 SO2=1.0 NO2=0.5 O3=0.5 - IUT = 390, Oracle = 390, V3
Test 14 Pass! RSP=100.0 SO2=1.0 NO2=0.5 O3=0.5 - IUT = 490, Oracle = 490, V3
Test 15 Pass! RSP=50.0 SO2=1.0 NO2=1.499 O3=0.5 - IUT = 552, Oracle = 552, V3
Test 16 Pass! RSP=50.0 SO2=1.0 NO2=0.5 O3=1.499 - IUT = 519, Oracle = 519, V3
Test 17 Pass! RSP=50.0 SO2=0.501 NO2=0.5 O3=0.5 - IUT = 350, Oracle = 350, V3
Test 18 Pass! RSP=50.0 SO2=2.999 NO2=0.5 O3=0.5 - IUT = 862, Oracle = 862, V3
Test 19 Pass! RSP=0.0 SO2=0.2 NO2=0.5 O3=0.5 - IUT = 8, Oracle = 8, V4
Test 20 Fail! RSP=100.0 SO2=0.2 NO2=0.5 O3=0.5 - IUT = 1500, Oracle = 58, V4
Test 21 Pass! RSP=50.0 SO2=0.2 NO2=0.0 O3=0.5 - IUT = 30, Oracle = 30, V4
Test 22 Pass! RSP=50.0 SO2=0.2 NO2=0.5 O3=0.0 - IUT = 30, Oracle = 30, V4
Test 23 Pass! RSP=50.0 SO2=0.0 NO2=0.5 O3=0.5 - IUT = 32, Oracle = 32, V4
Test 24 Fail! RSP=50.0 SO2=0.5 NO2=0.5 O3=0.5 - IUT = 350, Oracle = 36, V4
========== End of test ==========
```

log.log:

```
Apr 04, 2016 7:38:10 PM A1_2.Harness main
INFO: test mode: 1, test file: test.txt
Apr 04, 2016 7:38:10 PM A1_2.Harness RunDomainTest
WARNING: Test 2 Fail! RSP=300.0 SO2=1.0 NO2=0.5 O3=0.5 - IUT = 5000, Oracle = 4861, V1
```

Apr 04, 2016 7:38:10 PM A1_2.Harness RunDomainTest
WARNING: Test 3 Fail! RSP=200.0 SO2=1.0 NO2=1.499 O3=0.5 - IUT = 3254, Oracle = 3244, V1
Apr 04, 2016 7:38:11 PM A1_2.Harness RunDomainTest
WARNING: Test 8 Fail! RSP=300.0 SO2=0.2 NO2=0.5 O3=0.5 - IUT = 4950, Oracle = 4500, V2
Apr 04, 2016 7:38:12 PM A1_2.Harness RunDomainTest
WARNING: Test 20 Fail! RSP=100.0 SO2=0.2 NO2=0.5 O3=0.5 - IUT = 1500, Oracle = 58, V4
Apr 04, 2016 7:38:13 PM A1_2.Harness RunDomainTest
WARNING: Test 24 Fail! RSP=50.0 SO2=0.5 NO2=0.5 O3=0.5 - IUT = 350, Oracle = 36, V4
Apr 04, 2016 7:38:13 PM A1_2.Harness main
INFO: test is done!

Anomaly Reports for Streamlined Domain Testing

COMP3403A1P2_DT_Anomaly1

Description	**fail in test case 2 with IUT = 5000, Oracle = 4861. Test in V1**
Inputs	RSP=300.0 SO2=1.0 NO2=0.5 O3=0.5
Expected Result	4861
Actual Result	5000

COMP3403A1P2_DT_Anomaly2

Description	fail in test case 3 with IUT = 3254, Oracle = 3244. Test in V1
Inputs	RSP=200.0 SO2=1.0 NO2=1.499 O3=0.5 - IUT = 3254
Expected Result	3244
Actual Result	3254

COMP3403A1P2_DT_Anomaly3

Description	fail in test case 8 with IUT = 4950, Oracle = 4500. Test in V2
Inputs	RSP=300.0 SO2=0.2 NO2=0.5 O3=0.5 - IUT = 4950
Expected Result	4500
Actual Result	4950

COMP3403A1P2_DT_Anomaly4

Description	fail in test case 20 with IUT = 1500, Oracle = 58. Test in V4
Inputs	RSP=100.0 SO2=0.2 NO2=0.5 O3=0.5 - IUT = 1500
Expected Result	58
Actual Result	1500

COMP3403A1P2_DT_Anomaly5

Description	fail in test case 24 with IUT = 350, Oracle = 36. Test in V4
Inputs	RSP=50.0 SO2=0.5 NO2=0.5 O3=0.5 - IUT = 350
Expected Result	36
Actual Result	350

Reference: Test Cases for Streamlined Domain Testing

Test Case	RSP	SO2	NO2	O3	Variant
1	100.1	1	0.5	0.5	V1
2	**300**	1	0.5	0.5	V1
3	200	1	**1.499**	0.5	V1
4	200	1	0.5	1.499	V1
5	200	0.501	0.5	0.5	V1
6	200	2.999	0.5	0.5	V1
7	100.1	0.2	0.5	0.5	V2
8	**300**	0.2	0.5	0.5	V2
9	200	0.2	0	0.5	V2
10	200	0.2	0.5	0	V2
11	200	0	0.5	0.5	V2
12	200	0.5	0.5	0.5	V2
13	0	1	0.5	0.5	V3
14	100	1	0.5	0.5	V3
15	50	1	1.499	0.5	V3
16	50	1	0.5	1.499	V3
17	50	0.501	0.5	0.5	V3
18	50	2.999	0.5	0.5	V3
19	0	0.2	0.5	0.5	V4
20	**100**	0.2	0.5	0.5	V4
21	50	0.2	0	0.5	V4
22	50	0.2	0.5	0	V4
23	50	0	0.5	0.5	V4
24	50	**0.5**	0.5	0.5	V4

Test Report for Random Testing

Document ID: COMP3403A1P2_RT

Modification from part 1 version: A converter.java is added for assisting column data retrieving in constructing failed-case table.

Time of Testing: 17mins

Test Start Time: Apr 04, 2016 7:41:37 PM

Test End Time: Apr 04, 2016 7:58:50 PM

Procedure Results:

Cases	RSP	SO2	NO2	O3	IUT	Oracle	Variant
1	170.1	0.141	0.422	0.148	2616	2551	2
2	170.2	0.621	1.218	1.295	2825	2760	1
3	170.1	1.874	0.627	0.853	2822	2757	1
4	95.8	1.036	1.024	0.379	2545	545	3
5	147.2	1.392	1.499	0.992	2399	2389	1
6	219.2	0.628	1.499	1.309	3565	3555	1
7	32.4	2.661	0.801	0.416	5000	815	3
8	196.7	2.620	1.499	0.336	3201	3191	1
9	170.1	2.279	0.884	0.453	2823	2758	1
10	170.2	2.868	0.784	1.154	2824	2759	1
11	82.7	0.065	0.235	0.082	310	44	4
12	170.1	2.111	0.077	0.928	2820	2755	1
13	73.5	1.747	0.704	0.000	687	587	3
14	170.2	1.619	1.045	0.587	2825	2760	1
15	59.9	1.024	0.960	0.388	2450	450	3
16	72.3	1.091	1.100	0.275	2540	540	3
17	170.2	1.154	0.891	0.038	2824	2759	1
18	1.8	0.069	0.303	0.206	37	5	4
19	168.9	2.592	1.499	0.646	2750	2740	1
20	24.8	1.037	0.844	0.289	2414	414	3
21	215.3	1.780	1.499	0.765	3502	3492	1
22	56.2	0.008	0.145	0.174	49	30	4
23	98.9	1.771	0.802	0.486	4396	627	3
24	91.9	0.063	0.182	0.040	338	48	3
25	29.9	1.060	1.062	0.292	2487	487	3
26	27.3	2.189	0.801	0.317	5000	716	3
27	160.8	2.148	1.499	0.606	2619	2609	1
28	21.8	1.395	1.084	0.000	645	545	3

Random Testing Summary:

Random testing generated 28 test case failures without other unresolved anomalies. Those anomaly test cases were documented in the table above with the help of convert.java. Corresponding variants were added for further comparison.

Compare Type of Defects Found

Types	V1	V2	V3	V4	Total
Streamlined Domain Testing	2	1	0	2	5
Random Testing	13	1	11	3	28

Comparison of Two Approaches:

Both 1X1 streamlined domain testing (1X1 SDT) and random testing (RT) were able to reveal some defects, but the efficiencies are quite different. 1X1 SDT reported 5 defects in 3 seconds (i.e., 1.67 defects/s), while RT took 17 minutes and got 28 defects (i.e., 0.0275 defects/s). Due to the inefficiency of Oracle and large number of randomly-generated test cases, the random testing on IUT was extremely slow. This is a typical trade-off when we consider whether we should spend time in designing tailored test cases and save time in testing, or save time by randomly generating large quantity of test cases and spend time in running these cases.

In terms of type of defects revealed, 1X1 SDT and RT have different tendency. 1X1 SDT combines both domain testing and subdomain boundary probing. It is difficult for 1X1 SDT to detect some defects deep inside a subdomain, because it only probing the boundary of such a subdomain. In contract, RT is able to reveal some defects in the middle of subdomains because every point has equal opportunity to be tested, while it is not easy for RT to find defects along each boundary. The V3 column in the table above illustrate such difference between 1X1 SDT and RT.

To conclude, 1X1 streamlined domain testing is good at probing boundaries with high testing efficiency; random testing is good at finding defects that cannot be detected by 1X1 streamlined domain testing (e.g, in the middle of subdomains) and the cost is very low in generating large amount of test cases. We should combine both techniques to enhance testing.