

Table 1: Teco dataset projects basic information.

Types	# projects
total	1535
single-module	1209
exist	1196
2019	77
2020	179
2021	277
2022	128

A DATASET

Table 1 shows the distribution of projects by their latest release/commit data from Teco’s dataset [1] when we checked in Spring 2022.

B EXPERIMENT RESULTS

Table 2 shows the number of target statements covered by unit tests, and the number of target statements of each kind (regular experssion, string manipulation, bit manipulation and stream).

Table 3 shows the number of target statements and generated inline tests.

Table 4 lists the mutation operators used by universalmutator in our experiments.

Figure 1 shows the Venn diagram of the mutants killed by inline tests, developer-written unit tests, and Randoop-generated unit tests.

Table 5 lists the 250 mutants (from 56 target statement in 14 projects) killed by R1 but not killed by R0.

There are 4 reasons that R1 killed less mutants than R0

- coverage is line level not instruction level (3 target statements)
- group() is for the whole conditional expression, not for each condition (11 target statements)
- coverage for bit manipulation does not change (35 target statements)
- String wrapper does not override indexOf, valueOf (7 target statements)

Table 6 lists the 532 mutants (from 165 target statements in 17 projects) not killed by any kind of tests.

For the 1385 mutants that are not killed by developer-written unit tests, 897 mutants related target statements are covered by developer-written unit tests, and 488 mutants related target statements are not covered by developer-written unit tests.

For the 2711 mutants that are not killed by Randoop-generated unit tests, 1084 mutants related target statements are covered by Randoop-generated unit tests, and 1627 mutants related target statements are not covered by Randoop-generated unit tests.

Table 2: Target statements. All: Total number of target statements. **T:** Number of target statements covered by tests (developer-written unit tests or Randoop generated tests). T_M : Number of methods that contain the target statements covered by tests (developer-written unit tests or Randoop generated tests). **DT:** Number of target statements covered by developer-written unit tests. DT_M : Number of methods that contain the target statements covered by developer-written unit tests. **RT:** Number of target statements covered by Randoop generated tests. RT_M : Number of methods that contain the target statements covered by Randoop generated tests.

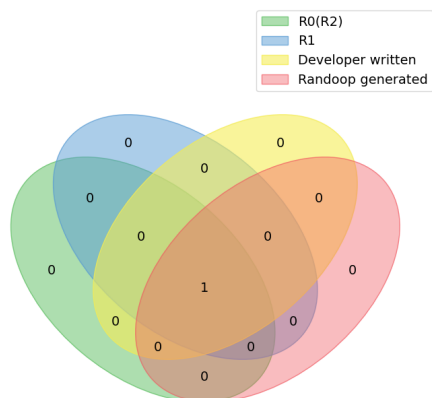
Project	# Total							# Stmts Regex				# Stmts String				# Stmts Bit				# Stmts Stream			
	All	T	T_M	DT	DT_M	RT	RT_M	All	T	DT	RT	All	T	DT	RT	All	T	DT	RT	All	T	DT	RT
Amazon-sqs-java-extended-client-lib	4	4	4	4	4	0	1	0	0	0	0	4	4	4	0	0	0	0	0	0	0	0	0
Aquarius-sdk-java	3	3	3	2	3	2	3	1	1	0	1	2	2	2	1	0	0	0	0	0	0	0	0
Build-helper-maven-plugin	24	12	22	12	12	11	22	13	12	12	11	11	0	0	0	0	0	0	0	0	0	0	0
Core	19	15	16	14	14	8	12	7	5	5	2	10	10	9	6	2	0	0	0	0	0	0	0
Cyclonedx-core-java	4	3	4	2	3	3	4	0	0	0	0	0	0	0	0	0	0	0	0	4	3	2	7
Elasticsearch-analysis-pinyin	3	3	3	3	3	1	2	0	0	0	0	0	0	0	0	3	3	3	1	0	0	0	7
Email-ext-plugin	14	13	13	13	13	2	4	2	2	2	0	11	10	10	2	0	0	0	0	1	1	1	7
Extclassgenerator	5	2	4	2	4	1	2	0	0	0	0	5	2	2	1	0	0	0	0	0	0	0	7
Fabric-sdk-java	22	19	21	19	21	4	5	7	7	7	1	11	8	8	2	3	3	3	1	1	1	1	0
Geoip-api-java	22	21	21	21	21	0	0	0	0	0	0	0	0	0	0	22	21	21	0	0	0	0	7
Gerrit-rest-java-client	17	14	14	12	12	7	7	4	4	4	0	8	8	7	5	5	2	1	2	0	0	0	7
Java-asana	247	246	246	25	25	241	241	0	0	0	0	247	246	25	241	0	0	0	0	0	0	0	7
Jopenfst	7	4	4	4	4	0	0	0	0	0	0	2	2	2	0	5	2	2	0	0	0	0	7
Jproc	2	2	2	2	2	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	7
Jscep	4	4	4	2	2	2	4	1	1	1	0	1	1	1	0	2	2	0	2	0	0	0	0
Liquibase-oracle	4	2	2	0	0	2	2	0	0	0	0	4	2	0	2	0	0	0	0	0	0	0	7
Logstash-gelf	54	37	40	37	39	19	28	8	8	8	2	33	23	23	14	13	6	6	3	0	0	0	8
Maven-site-fixer	1	1	1	1	1	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	8
Messageutil-utils	43	40	42	40	41	25	31	5	5	5	3	22	20	20	14	1	1	1	1	15	14	14	7
Mp3agic	34	34	34	34	34	31	32	0	0	0	0	6	6	6	6	28	28	28	25	0	0	0	0
Nfe	251	44	234	37	37	33	228	25	25	24	24	222	16	10	8	0	0	0	0	4	3	3	1
Ognl	179	138	174	136	169	40	105	1	1	1	1	26	22	22	7	152	115	113	32	0	0	0	8
Pdfcompare	10	9	10	9	10	4	4	4	4	4	0	2	1	1	0	1	1	1	1	3	3	3	8
Ph-pdf-layout	2	2	2	2	2	2	2	0	0	0	0	0	0	0	0	2	2	2	2	0	0	0	8
Properties-maven-plugin	6	6	6	6	6	0	0	0	0	0	0	6	6	6	0	0	0	0	0	0	0	0	0
Property-loader	5	4	5	4	5	2	4	2	1	1	1	3	3	3	1	0	0	0	0	0	0	0	0
Restfb	24	20	21	19	20	12	17	4	3	3	2	13	11	10	5	4	4	4	4	3	2	2	8
Sherdog-parser	9	9	9	8	8	9	9	0	0	0	0	5	5	4	5	0	0	0	0	4	4	4	8
Trema-core	10	9	10	9	9	5	6	1	1	1	0	9	8	8	5	0	0	0	0	0	0	0	9
Velocity-config-tool	2	2	2	2	2	0	0	0	0	0	0	2	2	2	0	0	0	0	0	0	0	0	9
Visearch-sdk-java	4	4	4	4	4	4	4	0	0	0	0	4	4	4	4	0	0	0	0	0	0	0	0
Total	1035	726	977	485	530	471	780	86	81	79	49	671	424	191	329	243	190	185	74	35	31	30	19

Table 3: Generated and reduced inline tests. # target stmts: Total number of target statements that are covered by initial inline tests. # Values ITs: Total number of unique inline tests collected in memory. # R0 ITs: Total number of inline tests without reduction. # R1 ITs: Total number of round 1 reduced inline tests. # R2 ITs: Total number of round 2 reduced inline tests.

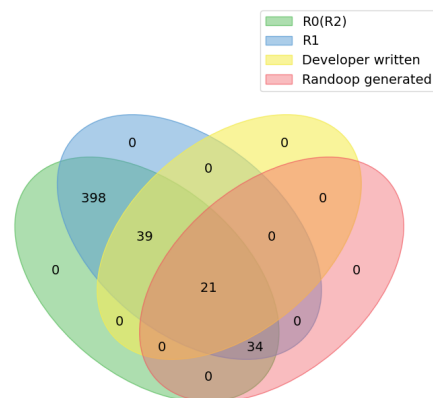
PID	# target stmts	# Values ITs	# R0 ITs	# R1 ITs	# R2 ITs
P1	4	67	67	4	4
P2	3	19	19	4	3
P3	12	305	254	46	14
P4	11	83	83	17	11
P5	3	52	52	5	3
P6	3	115	84	11	7
P7	4	36	22	7	5
P8	2	24	15	3	2
P9	17	100	100	29	18
P10	16	1765	442	34	30
P11	9	749	146	13	11
P12	245	1000	1000	253	248
P13	2	21	21	2	3
P14	2	60	26	3	2
P15	3	428	214	6	3
P16	2	10	10	2	2
P17	35	16388	1537	61	47
P18	1	1	1	1	1
P19	17	10378	446	37	22
P20	32	11308	1738	46	43
P21	40	1120	956	74	53
P22	128	5828	2272	294	151
P23	5	36	36	14	5
P24	2	524	133	2	3
P25	6	72	72	6	6
P26	3	31	25	3	2
P27	19	1496	809	34	22
P28	4	36524	451	7	6
P29	7	128	50	9	10
P30	1	6	6	1	2
P31	4	8	4	4	4
Total	642	88682	11091	1032	743

Table 4: Summary of mutation operators

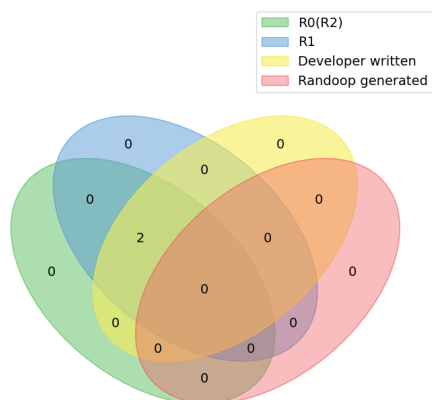
Mutation operators	original	mutated
absolute val of negative val '-'	-n	n
boolean <i>and</i> with true	bool1 && bool2	true && bool2 bool1 && true
boolean <i>or</i> with false	bool1 bool2	false bool2 bool1 false
change += to ==	val1 += val2	val1 == val2
change binary arithmetic operator	+, -, *, /, %	+, -, *, /, %
change binary logical bitwise operator	val1 val2 val1 & val2	val1 & val2 val1 val2
change binary logical operator	bool1 bool2 bool1 && bool2	bool1 && bool2 bool1 bool2
change comparator	>, <, !=, >=, <=, ==	>, <, !=, >=, <=, ==
change constant	n	-1, 0, 1, (n-1), (n+1)
delete repeating function	obj.func(x).func(y)	obj.func(x)
delete string	".."	""
negate if-statement	if(...) if(!...)	if(!...) if(!(!(...)))
remove else	else if(...)	if(...)
remove unary operator	!boolean	boolean
reverse increment/decrement	val++ val--	val-- val++
reverse max/min	max(...) min(...)	min(...) max(...)
swap argument order	function(x, y)	function(y, x)



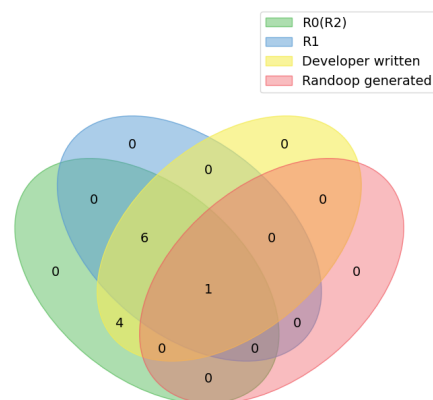
(a) aquarius-sdk-java



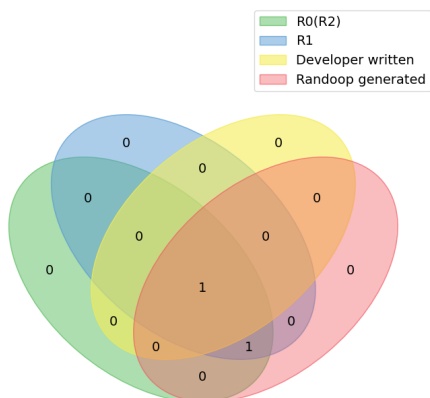
(b) java-asana



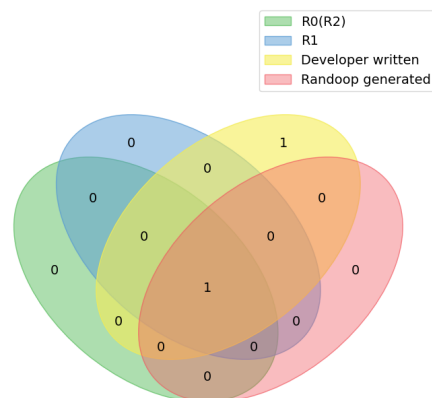
(c) maven-site-fixer



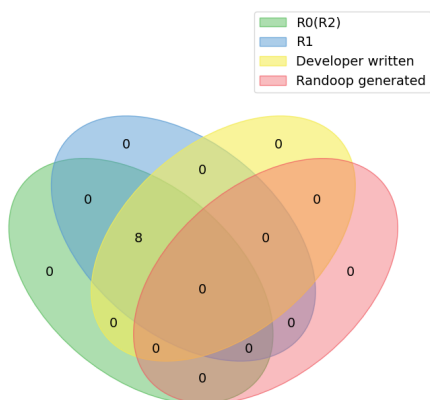
(d) velocity-config-tool



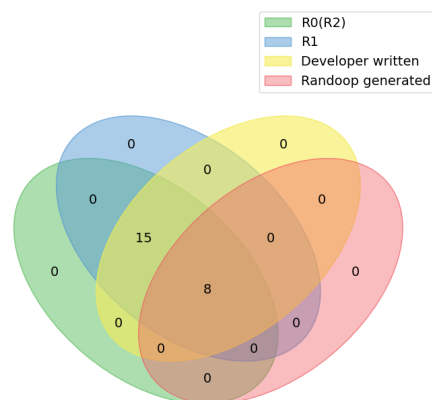
(e) cyclonedx-core-java



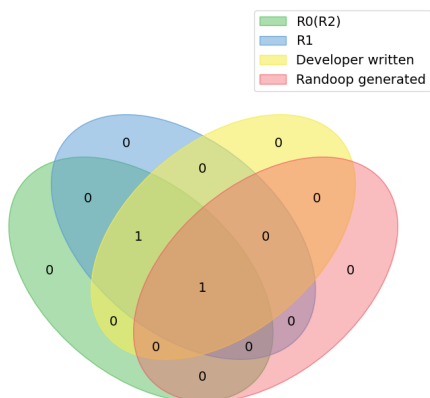
(f) property-loader



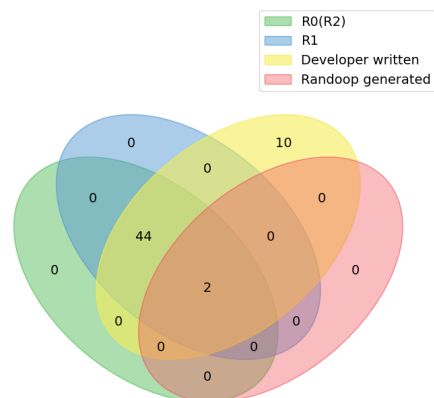
(g) amazon-sqs-java-extended-client-lib



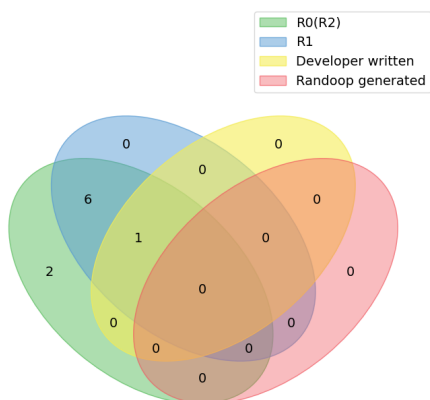
(h) core



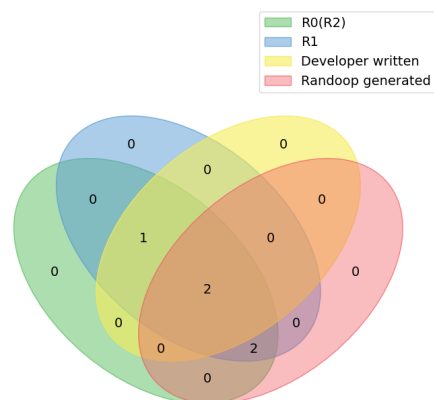
(i) jproc



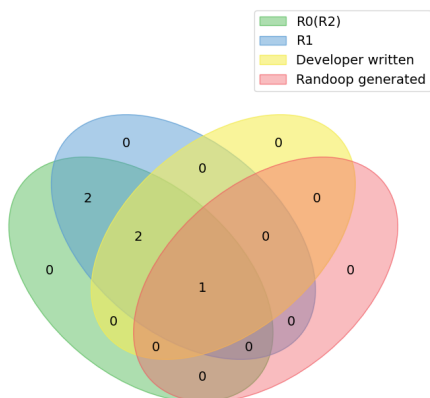
(j) fabric-sdk-java



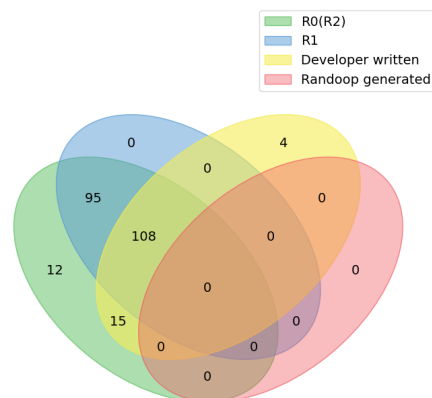
(k) email-ext-plugin



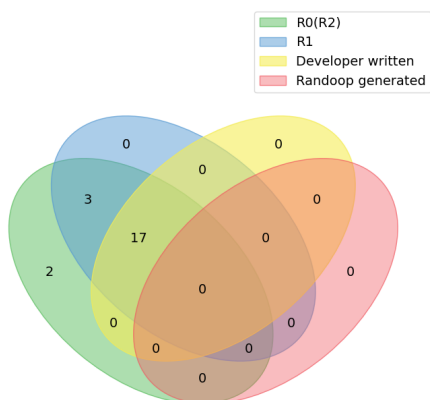
(l) jscep



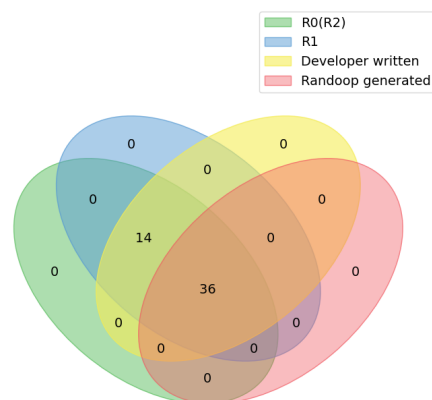
(m) sherdog-parser



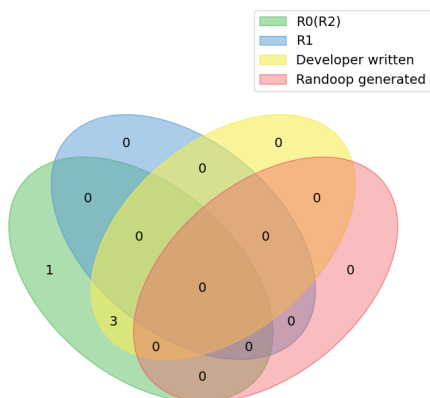
(n) geoip-api-java



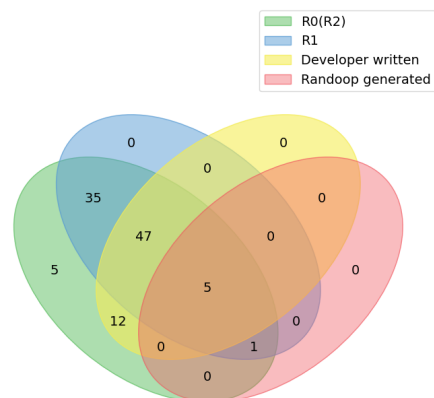
(o) elasticsearch-analysis-pinyin



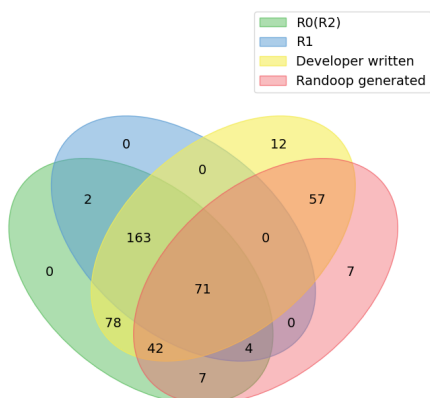
(p) build-helper-maven-plugin



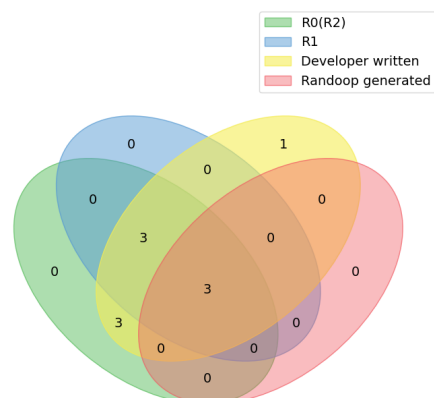
(q) properties-maven-plugin



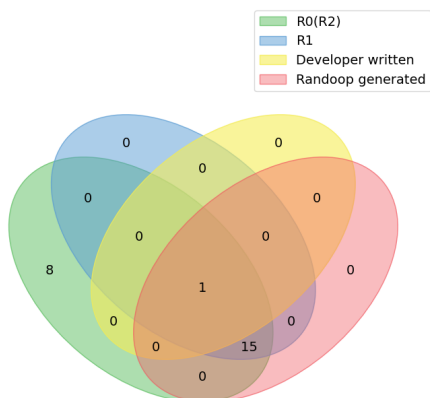
(r) logstash-gelf



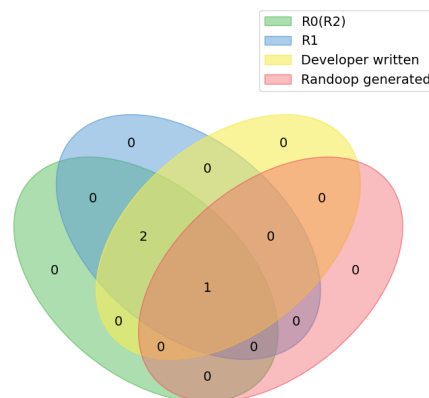
(s) mp3agic



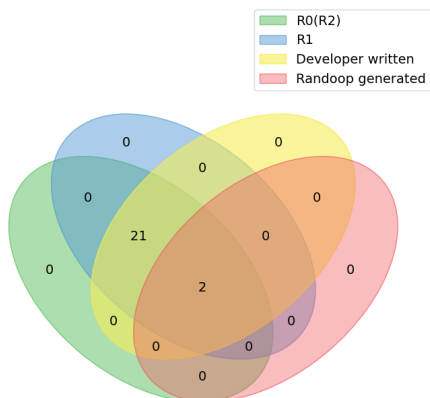
(t) trema-core



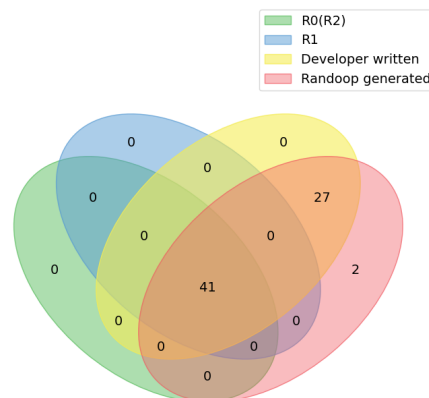
(u) ph-pdf-layout



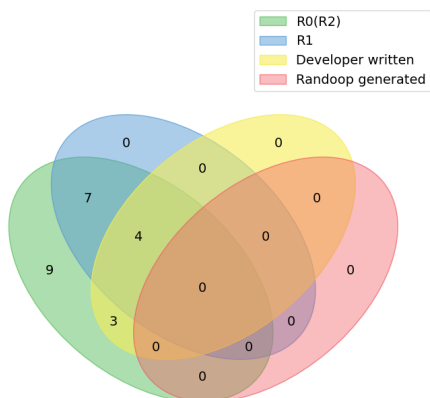
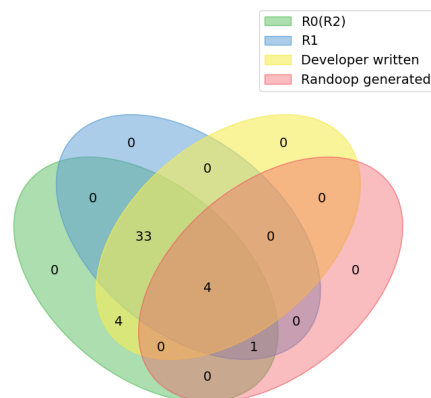
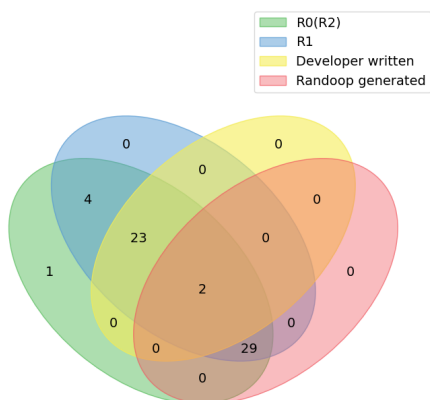
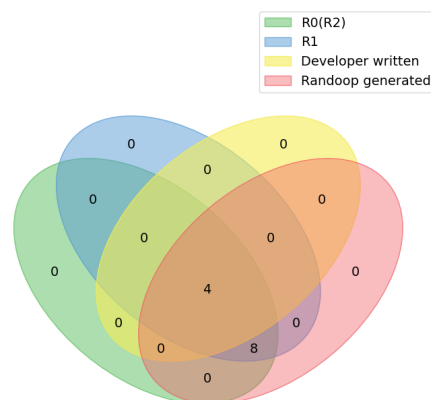
(v) extclassgenerator

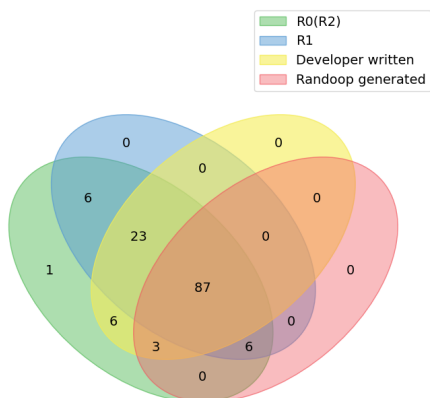


(w) pdfcompare

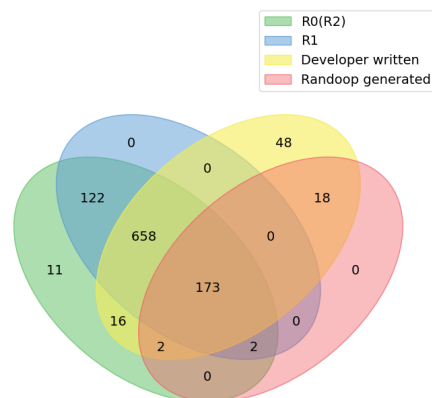


(x) restfb

**(y) jopenfst****(z) messageml-utils****(aa) gerrit-rest-java-client****(ab) visearch-sdk-java**



(ac) nfe



(ad) ognl

Figure 1: Sets of mutants killed by inline tests and unit tests.

Table 5: R1 tests missed mutants that are killed by R0 tests.

Target stmt	Original code	Mutated code	Reason
velocity-config-tool ConfigTool 288	<pre>corrected = text.replace('/', '-').replace('\\\\', '-').replace('.', '-')</pre>	<pre>corrected = text.replace('/', '-').replace('\\\\', '-').replace('.', '%')</pre>	coverage is line level not instruction level.
email-ext-plugin ExtendedEmailPublisherDescriptor 498	<pre>if (value.matches("@[A-Za-z0-9.\\-]+") Util.fixEmptyAndTrim(value)==null)</pre>	<pre>if (value.matches("") Util.fixEmptyAndTrim(value)==null)</pre>	group() is for the whole conditional expression, not for each condition.
geoip-api-java LookupService 549	<pre>if (read == 3 && (delim[0] & 0xFF) == 255</pre>	<pre>if (read == 3 && (delim[(0+1)] & 0xFF) == 255</pre>	group() is for the whole conditional expression, not for each condition.
geoip-api-java LookupService 882	<pre>int bMask = 1 << (bnum & 7 ^ 7);</pre>	<pre>int bMask = 1 << (bnum & (7-1) ^ 7);</pre>	coverage for bit manipulation is not enough.
geoip-api-java LookupService 883	<pre>if ((v6vec[idx] & bMask) > 0) {</pre>	<pre>if ((v6vec[idx] & bMask) > 1) {</pre>	coverage for bit manipulation is not enough.
geoip-api-java LookupService 917	<pre>if ((ipAddress & (1 << depth)) > 0) {</pre>	<pre>if ((ipAddress (1 << depth)) > 0) {</pre>	coverage for bit manipulation is not enough.
geoip-api-java LookupService 958	<pre>x[i] += (y << (j * 8));</pre>	<pre>x[i] += (y << (j * -1));</pre>	coverage for bit manipulation is not enough.
geoip-api-java LookupService 977	<pre>ipnum += y << ((3 - i) * 8);</pre>	<pre>ipnum += y << ((3 - i) * 8);</pre>	coverage for bit manipulation is not enough.

elasticsearch-analysis-pinyin PinyinAlphabetTokenizer 59	<pre>if (lastWord & sb.length()>0) {</pre>	<pre>if (lastWord & sb.length()>(0+1)) {</pre>	coverage for bit manipulation is not enough.
properties-maven-plugin ExpansionBuffer 35	<pre>int prefixPos = unresolved.indexOf("\${") ;</pre>	<pre>int prefixPos = unresolved.indexOf("");</pre>	String wrapper does not override indexOf.
properties-maven-plugin ExpansionBuffer 36	<pre>int suffixPos = unresolved.indexOf(")", prefixPos + 2);</pre>	<pre>int suffixPos = unresolved.indexOf(")", prefixPos * 2);</pre>	String wrapper does not override indexOf.
properties-maven-plugin ExpansionBuffer 98	<pre>int propertyPrefixPos = unresolved.indexOf ("\${");</pre>	<pre>int propertyPrefixPos = unresolved.indexOf ("");</pre>	String wrapper does not override indexOf.
properties-maven-plugin ExpansionBuffer 104	<pre>int propertyPrefixPos = unresolved.indexOf ("\${");</pre>	<pre>int propertyPrefixPos = unresolved.indexOf ("");</pre>	String wrapper does not override indexOf.
logstash-gelf RuntimeContainer 121	<pre>if (hostname.indexOf('.') != -1 && !fqdn) {</pre>	<pre>if (hostname.indexOf('.') != -(1+1) && ! fqdn) {</pre>	coverage for bit manipulation is not enough.
logstash-gelf StackTraceFilter 440	<pre>if (endsWithNewLine && AT_PATTERN.matcher(toWrite).find()) {</pre>	<pre>if (endsWithNewLine AT_PATTERN.matcher(toWrite).find()) {</pre>	group() is for the whole conditional expression, not for each condition.
logstash-gelf ValueDiscovery 46	<pre>numbersOnly &= (c >= '0' && c <= '9');</pre>	<pre>numbersOnly &= (c <= '0' && c <= '9');</pre>	coverage for bit manipulation is not enough.

mp3agic BufferTools 90	newByte = (byte) (b & ~((byte) 0x01 << bitPosition)));	newByte = (byte) (b & ~((byte) 0x0 << bitPosition)));	coverage for bit manipulation is not enough.
mp3agic BufferTools 116	bytes[2] = (byte) ((i >> 8) & 0xff);	bytes[2] = (byte) ((i >> (8-1)) & 0xff);	coverage for bit manipulation is not enough.
mp3agic BufferTools 117	bytes[1] = (byte) ((i >> 16) & 0xff);	bytes[1] = (byte) ((i >> -1) & 0xff);	coverage for bit manipulation is not enough.
mp3agic BufferTools 124	value += shiftByte((byte) (b3 & 0x7f), -7);	value += shiftByte((byte) (b3 & 0x1f), -7);	coverage for bit manipulation is not enough.
mp3agic BufferTools 125	value += shiftByte((byte) (b2 & 0x7f), -14);	value += shiftByte((byte) (b2 & 0x7f), 14);	coverage for bit manipulation is not enough.
mp3agic BufferTools 126	value += shiftByte((byte) (b1 & 0x7f), -21);	value += shiftByte((byte) (b1 & 0x7f), 21);	coverage for bit manipulation is not enough.
mp3agic BufferTools 137	bytes[offset + 3] = (byte) (i & 0x7f);	bytes[offset + 3] = (byte) (i & 0x1f);	coverage for bit manipulation is not enough.
mp3agic BufferTools 138	bytes[offset + 2] = (byte) ((i >> 7) & 0x7f);	bytes[offset + 2] = (byte) ((i >> 7) & 0x1f);	coverage for bit manipulation is not enough.

mp3agic BufferTools 139	bytes[offset + 1] = (byte) ((i >> 14) & 0 x7f);	bytes[offset + 1] = (byte) ((i >> (14-1)) & 0x7f);	coverage for bit manipulation is not enough.
mp3agic BufferTools 140	bytes[offset + 0] = (byte) ((i >> 21) & 0 x7f);	bytes[offset + 0] = (byte) ((i >> 21) & 0 x0f);	coverage for bit manipulation is not enough.
mp3agic BufferTools 160	if (bytes[i] == (byte) 0xff && ((bytes[i + 1] & (byte) 0xe0) == (byte) 0xe0 bytes[i + 1] == 0)) {	if (bytes[i] == (byte) 0xff && ((bytes[i * 1] & (byte) 0xe0) == (byte) 0xe0 bytes[i + 1] == 0)) {	group() is for the whole conditional expression, not for each condition.
mp3agic BufferTools 178	if (bytes[i] == (byte) 0xff && ((bytes[i + 1] & (byte) 0xe0) == (byte) 0xe0 bytes[i + 1] == 0)) {	if (bytes[i] == (byte) 0xff && ((bytes[i + 1] & (byte) 0xe0) == (byte) 0xe0 bytes[i + 1] == 1)) {	group() is for the whole conditional expression, not for each condition.
mp3agic BufferTools 192	if (bytes[i] == (byte) 0xff && bytes[i + 1] == 0 && ((bytes[i + 2] & (byte) 0 xe0) == (byte) 0xe0 bytes[i + 2] == 0)) {	if (bytes[i] == (byte) 0xff && bytes[i + 1] == 0 && ((bytes[i + 2] & (byte) 0 xe0) == (byte) 0xe0 bytes[i + (2+1)] == 0)) {	group() is for the whole conditional expression, not for each condition.
mp3agic BufferTools 210	if (bytes[i] == (byte) 0xff && bytes[i + 1] == 0 && ((bytes[i + 2] & (byte) 0 xe0) == (byte) 0xe0 bytes[i + 2] == 0)) {	if (bytes[i] == (byte) 0xff && bytes[i + 1] == 0 && ((bytes[i + 2] & (byte) 0 xe0) == (byte) 0xe0 bytes[i + (2+1)] == 0)) {	group() is for the whole conditional expression, not for each condition.
mp3agic MpegFrame 92	if (((bitMask >> i) & 1) != 0) {	if (((bitMask >> i) & (1+1)) != 0) {	coverage for bit manipulation is not enough.

trema-core HtmlLineBreakConverter 21	String newValue = StringUtils.replace(value, "\\r\\n", REPLACEMENT);	String newValue = StringUtils.replace(value, REPLACEMENT, "\\r\\n");	coverage is line level not instruction level.
trema-core HtmlLineBreakConverter 23	newValue = StringUtils.replace(newValue, " \\r", REPLACEMENT);	newValue = StringUtils.replace(newValue, " ", REPLACEMENT);	coverage is line level not instruction level.
ph-pdf-layout LoadedFont 74	ret <= 8;	ret <= 1;	coverage for bit manipulation is not enough.
ph-pdf-layout LoadedFont 75	ret = (b + 256) % 256;	ret = (b % 256) % 256;	coverage for bit manipulation is not enough.
jopenfst IndexWeight 66	result = 31 * result + (int) (temp ^ (temp >>> 32));	result = 0 * result + (int) (temp ^ (temp >>> 32));	coverage for bit manipulation is not enough.
messageml-utils DateInterval 57	if(Arrays.stream(daysOfWeek).anyMatch(d -> d < 0 d > 6)){	if(Arrays.stream(daysOfWeek).anyMatch(d -> d < 0 d >= 6)){	group() is for the whole conditional expression, not for each condition.
gerrit-rest-java-client StandardKeyEncoder 81	if (e.indexOf('%') < 0) {	if (e.indexOf('/') < 0) {	String wrapper does not override indexOf.
nfe DFUtils 107	final String nDigResult = String.valueOf(digito1) + digito2;	final String nDigResult = String.valueOf(digito1) + digito1;	String wrapper does not override valueOf.

nfe DFBigDecimalValidador 83	<pre>if (valor.toPlainString().length() > tamanho StringUtils.split(valor. toPlainString(), ".")[0].length() > (tamanho - (posicaoPontoFlutuante + 1)) valor.scale() > posicaoPontoFlutuante) {</pre>	<pre>if (valor.toPlainString().length() > tamanho StringUtils.split(valor. toPlainString(), ".")[0].length() >= (tamanho - (posicaoPontoFlutuante + 1)) valor.scale() > posicaoPontoFlutuante) {</pre>	group() is for the whole conditional expression, not for each condition.
nfe NFVerificaChave 35	<pre>valorTemp = Integer.parseInt(String. valueOf(valores[i - 1]));</pre>	<pre>valorTemp = Integer.parseInt(String. valueOf(valores[i - (1+1)]));</pre>	String wrapper does not override valueOf.
ognl OgnlParserTokenManager 100	<pre>if ((active0 & 0x201c4055d555540L) != 0L)</pre>	<pre>if ((active0 & 0x201c1d5555540L) != 0L)</pre>	coverage for bit manipulation is not enough.
ognl OgnlParserTokenManager 655	<pre>if ((0x3ff000000000000L & 1) != 0L)</pre>	<pre>if ((0x0ff000000000000L & 1) != 0L)</pre>	coverage for bit manipulation is not enough.
ognl OgnlParserTokenManager 665	<pre>if ((0x3fe000000000000L & 1) != 0L)</pre>	<pre>if ((0x0fe000000000000L & 1) != 0L)</pre>	coverage for bit manipulation is not enough.
ognl OgnlParserTokenManager 697	<pre>if ((0x3ff000000000000L & 1) == 0L)</pre>	<pre>if ((0x0ff000000000000L & 1) == 0L)</pre>	coverage for bit manipulation is not enough.
ognl OgnlParserTokenManager 730	<pre>if ((0x3ff000000000000L & 1) != 0L)</pre>	<pre>if ((0x0ff000000000000L & 1) != 0L)</pre>	coverage for bit manipulation is not enough.
ognl OgnlParserTokenManager 748	<pre>if ((0x3ff000000000000L & 1) != 0L)</pre>	<pre>if ((0x0ff000000000000L & 1) != 0L)</pre>	coverage for bit manipulation is not enough.

ognl OgnlParserTokenManager 763	if ((0x3ff000000000000L & 1) != 0L)	if ((0x0ff000000000000L & 1) != 0L)	coverage for bit manipulation is not enough.
ognl OgnlParserTokenManager 799	if ((0x7fffffe87fffffeL & 1) != 0L)	if ((0x7fffffe0fffffeL & 1) != 0L)	coverage for bit manipulation is not enough.
ognl OgnlParserTokenManager 809	if ((0x7fffffe87fffffeL & 1) == 0L)	if ((0x7fffffe0fffffeL & 1) == 0L)	coverage for bit manipulation is not enough.
ognl OgnlParserTokenManager 1072	if ((0xffffffff7fffffffffL & 1) != 0L && kind > 72)	if ((0xffffffff0fffffffffL & 1) != 0L && kind > 72)	coverage for bit manipulation is not enough.
ognl OgnlParserTokenManager 1130	long l1 = 1L << (hiByte & 077);	long l1 = 1L << (hiByte & (077-1));	coverage for bit manipulation is not enough.
ognl OgnlParserTokenManager 1132	long l2 = 1L << (curChar & 077);	long l2 = 1L << (curChar & (077-1));	coverage for bit manipulation is not enough.
ognl OgnlParserTokenManager 1229	long l = 1L << (curChar & 077);	long l = 1L << (curChar & (077-1));	coverage for bit manipulation is not enough.
ognl JavaCharStream 300	if ((c == 'u') && ((backSlashCnt & 1) == 1))	if ((c >= 'u') && ((backSlashCnt & 1) == 1))	group() is for the whole conditional expression, not for each condition.
ognl OgnlParser 3209	if ((jj_la1_1[i] & (1<<j)) != 0) {	if ((jj_la1_1[i] & ((1+1)<<j)) != 0) {	group() is for the whole conditional expression, not for each condition.

Table 6: R0, developer-written unit tests, and Randoop generated tests missed mutants.

Target stmt	Original code	Mutated code
maven-site-fixer SiteTool 376	<code>texts = text.split("-", 2);</code>	<code>texts = text.split("-", -1);</code>
velocity-config-tool ConfigTool 288	<code>corrected = text.replace('/', '-').replace ('\\\\', '-').replace('.', '-')</code>	<code>corrected = text.replace('%', '-').replace ('\\\\', '-').replace('.', '-')</code>
property-loader VariableResolvingFilter 20	<code>int endIndex = value.indexOf(VARIABLE_SUFFIX, startIndex + VARIABLE_PREFIX.length());</code>	<code>int endIndex = value.indexOf(VARIABLE_SUFFIX, startIndex / VARIABLE_PREFIX.length());</code>
amazon-sqs-java-extended-client-lib AmazonSQSExtendedClient 340	<code>largeMessagePointer = largeMessagePointer. replace("com.amazon.sqs.javamessaging. MessageS3Pointer", "software.amazon. payloadoffloading.PayloadS3Pointer");</code>	<code>largeMessagePointer = largeMessagePointer. replace("com.amazon.sqs.javamessaging. MessageS3Pointer", "");</code>
amazon-sqs-java-extended-client-lib AmazonSQSExtendedClient 891	<code>int secondOccurence = receiptHandle. indexOf(marker, firstOccurence + 1);</code>	<code>int secondOccurence = receiptHandle. indexOf(marker, firstOccurence + (1+1));</code>
core ReplaceSubstringUrlTransformer 51	<code>String result = url.replace(substringToReplace, replacement);</code>	<code>String result = url.replace(replacement, substringToReplace);</code>
fabric-sdk-java ChaincodeEndorsementPolicy 90	<code>if (match.matches() && match.groupCount() == 1) {</code>	<code>if (match.matches() && match.groupCount() >= 1) {</code>

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1930	1978
1931	1979
1932	1980
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1935	1983
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1942	1990
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1960	2008
1961	2009
1962	2010
1963	2011
1964	2012
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1966	2014
1967	2015
1968	2016
1969	2017
1970	2018
1971	2019
1972	2020
1973	2021
1974	2022
1975	2023
1976	2024

fabric-sdk-java ChaincodeCollectionConfiguration 289	<code>if (match.matches() && match.groupCount() == 1) {</code>	<code>if (match.matches() && match.groupCount() >= 1) {</code>
fabric-sdk-java Endpoint 345	<code>if (match.matches() && match.groupCount() == 1) {</code>	<code>if (match.matches() && match.groupCount() >= 1) {</code>
geoup-api-java LookupService 549	<code>if (read == 3 && (delim[0] & 0xFF) == 255</code>	<code>if (read <= 3 && (delim[0] & 0xFF) == 255</code>
geoup-api-java LookupService 304	<code>if ((dboptions & GEOIP_CHECK_CACHE) != 0) {</code>	<code>if ((dboptions & GEOIP_CHECK_CACHE) < 0) {</code>
geoup-api-java LookupService 374	<code>if ((dboptions & GEOIP_MEMORY_CACHE) == 1) {</code>	<code>if ((dboptions & GEOIP_MEMORY_CACHE) >= 1) {</code>
geoup-api-java LookupService 977	<code>ipnum += y << ((3 - i) * 8);</code>	<code>ipnum += y <<= ((3 - i) * 8);</code>
geoup-api-java LookupService 382	<code>if ((dboptions & GEOIP_INDEX_CACHE) != 0) {</code>	<code>if ((dboptions & GEOIP_INDEX_CACHE) > 0) {</code>
geoup-api-java LookupService 473	<code>if (file == null && (dboptions & GEOIP_MEMORY_CACHE) == 0) {</code>	<code>if (file != null && (dboptions & GEOIP_MEMORY_CACHE) == 0) {</code>

geoup-api-java LookupService 584	<code>if ((dboptions & GEOIP_CHECK_CACHE) != 0) {</code>	<code>if ((dboptions & GEOIP_CHECK_CACHE) < 0) {</code>
geoup-api-java LookupService 492	<code>if (file == null && (dboptions & GEOIP_MEMORY_CACHE) == 0) {</code>	<code>if (file != null && (dboptions & GEOIP_MEMORY_CACHE) == 0) {</code>
geoup-api-java LookupService 747	<code>if ((dboptions & GEOIP_MEMORY_CACHE) == 1) {</code>	<code>if ((dboptions & GEOIP_MEMORY_CACHE) >= 1) {</code>
geoup-api-java LookupService 883	<code>if ((v6vec[idx] & bMask) > 0) {</code>	<code>if ((v6vec[idx] & bMask)!= 0) {</code>
geoup-api-java LookupService 917	<code>if ((ipAddress & (1 << depth)) > 0) {</code>	<code>if ((ipAddress & (1 << depth))!= 0) {</code>
geoup-api-java LookupService 939	<code>} else if ((dboptions & GEOIP_INDEX_CACHE) != 0) {</code>	<code>} else if ((dboptions & GEOIP_INDEX_CACHE) > 0) {</code>
geoup-api-java LookupService 936	<code>if ((dboptions & GEOIP_MEMORY_CACHE) == 1) {</code>	<code>if ((dboptions & GEOIP_MEMORY_CACHE) >= 1) {</code>
geoup-api-java LookupService 958	<code>x[i] += (y << (j * 8));</code>	<code>x[i] += (y <= (j * 8));</code>

2121	elasticsearch-analysis-pinyin PinyinTokenizer 201	if (config.keepSeparateFirstLetter & pinyin.length() > 1) {	if (config.keepSeparateFirstLetter & pinyin.length() > 0) {	2169
2122				2170
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2125				2173
2126				2174
2127				2175
2128				2176
2129				2177
2130				2178
2131				2179
2132				2180
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2147				2195
2148				2196
2149				2197
2150				2198
2151				2199
2152				2200
2153				2201
2154				2202
2155				2203
2156				2204
2157				2205
2158				2206
2159				2207
2160				2208
2161				2209
2162				2210
2163				2211
2164				2212
2165				2213
2166				2214
2167				2215
2168				2216
	elasticsearch-analysis-pinyin PinyinTokenizer 201	if (config.keepSeparateFirstLetter & pinyin.length() > 1) {	if (config.keepSeparateFirstLetter & pinyin.length() > 0) {	
	elasticsearch-analysis-pinyin PinyinTokenFilter 145	if (config.keepSeparateFirstLetter & pinyin.length() > 1) {	if (config.keepSeparateFirstLetter & pinyin.length() > -1) {	
	build-helper-maven-plugin VersionInformation 70	if (matcher.group(7) != null)	if (matcher.group((7-1)) != null)	
	build-helper-maven-plugin VersionInformation 75	if (matcher.group(9) != null)	if (matcher.group((9-1)) != null)	
	properties-maven-plugin ExpansionBuffer 36	int suffixPos = unresolved.indexOf("}", prefixPos + 2);	int suffixPos = unresolved.indexOf("}", prefixPos + 1);	
	logstash-gelf RuntimeContainer 121	if (hostname.indexOf('.') != -1 && !fqdn) {	if (hostname.indexOf('.') > -1 && !fqdn) {	
	logstash-gelf StackTraceFilter 360	index = traceElement.indexOf(INDENT, index + 1);	index = traceElement.indexOf(INDENT, index + (1+1));	
	logstash-gelf StackTraceFilter 440	if (endsWithNewLine && AT_PATTERN.matcher(toWrite).find()) {	if (true && AT_PATTERN.matcher(toWrite). find()) {	

2217	logstash-gelf JsonWriter 295	<code>int hi = (charToEscape >> 8) & 0xFF;</code>	<code>int hi = (charToEscape >=> 8) & 0xFF;</code>	2265
2218				2266
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2221				2269
2222				2270
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2239				2287
2240				2288
2241				2289
2242				2290
2243				2291
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2249				2297
2250				2298
2251				2299
2252				2300
2253				2301
2254				2302
2255				2303
2256				2304
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2258				2306
2259				2307
2260				2308
2261				2309
2262				2310
2263				2311
2264				2312
	logstash-gelf JsonWriter 295	<code>int hi = (charToEscape >> 8) & 0xFF;</code>	<code>int hi = (charToEscape >=> 8) & 0xFF;</code>	
	logstash-gelf ReusableGzipOutputStream 134	<code>buf[offset + 1] = (byte) ((s >> 8) & 0xff) ;</code>	<code>buf[offset - 1] = (byte) ((s >> 8) & 0xff) ;</code>	
	logstash-gelf GelfMessage 655	<code>result = 31 * result + (int) (javaTimestamp ^ (javaTimestamp >>> 32));</code>	<code>result = 31 * result + (int) (javaTimestamp ^ (javaTimestamp >>> (32+1)));</code>	
	logstash-gelf ValueDiscovery 72	<code>} else if (doublePattern.matcher(value). matches()) {</code>	<code>} if (doublePattern.matcher(value).matches ()) {</code>	
	logstash-gelf ValueDiscovery 70	<code>} else if (longPattern.matcher(value). matches()) {</code>	<code>} if (longPattern.matcher(value).matches()) {</code>	
	logstash-gelf JulLogEvent 74	<code>if (message.indexOf('{') != -1) {</code>	<code>if (message.indexOf('{') > -1) {</code>	
	mp3agic BufferTools 210	<code>if (bytes[i] == (byte) 0xff && bytes[i + 1] == 0 && ((bytes[i + 2] & (byte) 0 xe0) == (byte) 0xe0 bytes[i + 2] == 0)) {</code>	<code>if (bytes[i] == (byte) 0xff && bytes[i + 1] == 0 && ((bytes[i + 2] & (byte) 0 xe0) == (byte) 0xe0 bytes[i + 1] == 0)) {</code>	
	mp3agic ID3v2ChapterTOCFrameData 42	<code>if ((flags & 0x01) == 0x01) {</code>	<code>if ((flags & 0x01) >= 0x01) {</code>	

2313	mp3agic BufferTools 178	if (bytes[i] == (byte) 0xff && ((bytes[i + 1] & (byte) 0xe0) == (byte) 0xe0 bytes[i + 1] == 0)) {	if (bytes[i] == (byte) 0xff && ((bytes[i + 1] & (byte) 0xe0) == (byte) 0xe0 bytes[i + 1] <= 0)) {
2314			
2315	mp3agic ID3v2ChapterTOCFrameData 45	if ((flags & 0x02) == 0x02) {	if ((flags & 0x02) >= 0x02) {
2316			
2317	mp3agic ID3v2ChapterTOCFrameData 96	b = 0x01;	b = 0x1;
2318			
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2320			
2321	mp3agic BufferTools 88	newByte = (byte) (b (((byte) 0x01 << bitPosition));	newByte = (byte) (b (((byte) 0x1 << bitPosition));
2322	mp3agic BufferTools 90	newByte = (byte) (b & ~((byte) 0x01 << bitPosition)));	newByte = (byte) (b & ~((byte) 0x1 << bitPosition)));
2323			
2324	mp3agic BufferTools 140	bytes[offset + 0] = (byte) ((i >> 21) & 0x7f);	bytes[offset + 0] = (byte) ((i >>= 21) & 0x7f);
2325			
2326	mp3agic BufferTools 192	if (bytes[i] == (byte) 0xff && bytes[i + 1] == 0 && ((bytes[i + 2] & (byte) 0xe0) == (byte) 0xe0 bytes[i + 2] == 0)) {	if (bytes[i] == (byte) 0xff && bytes[i + 1] == 0 && ((bytes[i + 2] & (byte) 0xe0) == (byte) 0xe0 bytes[i + 1] == 0)) {
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2409	mp3agic BufferTools 160	if (bytes[i] == (byte) 0xff && ((bytes[i + 1] & (byte) 0xe0) == (byte) 0xe0 bytes[i + 1] == 0)) {	if (bytes[i] == (byte) 0xff && ((bytes[i + 1] & (byte) 0xe0) <= (byte) 0xe0 bytes[i + 1] == 0)) {	2457
2410				2458
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2414				2462
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2416				2464
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gerrit-rest-java-client StandardKeyEncoder 81	<pre>if (e.indexOf('%') < 0) {</pre>	<pre>if (e.indexOf('%') < (0+1)) {</pre>
ognl OgnlParserTokenManager 100	<pre>if ((active0 & 0x201c4055d555540L) != 0L)</pre>	<pre>if ((active0 & 0x0c4055d555540L) != 0L)</pre>
ognl OgnlParserTokenManager 105	<pre>if ((active0 & 0x400000000000000L) != 0L)</pre>	<pre>if ((active0 & 0x0L) != 0L)</pre>
ognl OgnlParserTokenManager 107	<pre>if ((active0 & 0x100000000000000L) != 0L)</pre>	<pre>if ((active0 & 0x0L) != 0L)</pre>
ognl OgnlParserTokenManager 109	<pre>if ((active0 & 0x800000000000L) != 0L)</pre>	<pre>if ((active0 & 0x0L) != 0L)</pre>
ognl OgnlParserTokenManager 113	<pre>if ((active0 & 0x201c00550045500L) != 0L)</pre>	<pre>if ((active0 & 0x0c00550045500L) != 0L)</pre>
ognl OgnlParserTokenManager 122	<pre>if ((active0 & 0x4000d510040L) != 0L)</pre>	<pre>if ((active0 & 0x4000d510040L) > 0L)</pre>
ognl OgnlParserTokenManager 310	<pre>if ((active0 & 0x80L) != 0L)</pre>	<pre>if ((active0 & 0x80L) > 0L)</pre>
ognl OgnlParserTokenManager 314	<pre>if ((active0 & 0x20000000L) != 0L)</pre>	<pre>if ((active0 & 0x20000000L) > 0L)</pre>
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2601	ognl	OgnlParserTokenManager	324	else if ((active0 & 0x2000000L) != 0L)	if ((active0 & 0x2000000L) != 0L)	2649
2602						2650
2603						2651
2604						2652
2605						2653
2606						2654
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2608						2656
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	ognl	OgnlParserTokenManager	324	else if ((active0 & 0x2000000L) != 0L)	if ((active0 & 0x2000000L) != 0L)	
	ognl	OgnlParserTokenManager	322	else if ((active0 & 0x800000L) != 0L)	if ((active0 & 0x800000L) != 0L)	
	ognl	OgnlParserTokenManager	320	else if ((active0 & 0x20000L) != 0L)	if ((active0 & 0x20000L) != 0L)	
	ognl	OgnlParserTokenManager	318	if ((active0 & 0x8000L) != 0L)	if ((active0 & 0x8000L) > 0L)	
	ognl	OgnlParserTokenManager	328	if ((active0 & 0x80000000L) != 0L)	if ((active0 & 0x80000000L) > 0L)	
	ognl	OgnlParserTokenManager	341	if ((active0 & 0x8000000L) != 0L)	if ((active0 & 0x8000000L) > 0L)	
	ognl	OgnlParserTokenManager	350	if ((active0 & 0x10000L) != 0L)	if ((active0 & 0x10000L) > 0L)	
	ognl	OgnlParserTokenManager	354	if ((active0 & 0x40L) != 0L)	if ((active0 & 0x40L) > 0L)	
	ognl	OgnlParserTokenManager	365	else if ((active0 & 0x400000L) != 0L)	if ((active0 & 0x400000L) != 0L)	

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ognl OgnlParserTokenManager 360	if ((active0 & 0x100000L) != 0L)	if ((active0 & 0x100000L) > 0L)
ognl OgnlParserTokenManager 374	if ((active0 & 0x20L) != 0L)	if ((active0 & 0x20L) > 0L)
ognl OgnlParserTokenManager 384	if (((active0 &= old0)) == 0L)	if (((active0 &= old0)) <= 0L)
ognl OgnlParserTokenManager 394	if ((active0 & 0x200000000L) != 0L)	if ((active0 & 0x200000000L) > 0L)
ognl OgnlParserTokenManager 398	if ((active0 & 0x100L) != 0L)	if ((active0 & 0x100L) > 0L)
ognl OgnlParserTokenManager 404	else if ((active0 & 0x4000000L) != 0L)	if ((active0 & 0x4000000L) != 0L)
ognl OgnlParserTokenManager 402	if ((active0 & 0x1000000L) != 0L)	if ((active0 & 0x1000000L) > 0L)
ognl OgnlParserTokenManager 410	if ((active0 & 0x4000000L) != 0L)	if ((active0 & 0x4000000L) > 0L)
ognl OgnlParserTokenManager 418	if ((active0 & 0x40000L) != 0L)	if ((active0 & 0x40000L) > 0L)

2793	ognl	OgnlParserTokenManager	426	else if ((active0 & 0x100000000L) != 0L)	if ((active0 & 0x100000000L) != 0L)
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	ognl	OgnlParserTokenManager	426	else if ((active0 & 0x100000000L) != 0L)	if ((active0 & 0x100000000L) != 0L)
	ognl	OgnlParserTokenManager	424	else if ((active0 & 0x1000L) != 0L)	if ((active0 & 0x1000L) != 0L)
	ognl	OgnlParserTokenManager	422	if ((active0 & 0x400L) != 0L)	if ((active0 & 0x400L) > 0L)
	ognl	OgnlParserTokenManager	432	if ((active0 & 0x10000000L) != 0L)	if ((active0 & 0x10000000L) > 0L)
	ognl	OgnlParserTokenManager	438	if ((active0 & 0x2000000000000000L) != 0L)	if ((active0 & 0x2000000000000000L) > 0L)
	ognl	OgnlParserTokenManager	448	if (((active0 &= old0)) == 0L)	if (((active0 &= old0)) <= 0L)
	ognl	OgnlParserTokenManager	458	if ((active0 & 0x4000L) != 0L)	if ((active0 & 0x4000L) > 0L)
	ognl	OgnlParserTokenManager	462	if ((active0 & 0x4000000000000L) != 0L)	if ((active0 & 0x4000000000000L) > 0L)
	ognl	OgnlParserTokenManager	468	if ((active0 & 0x10000000000000L) != 0L)	if ((active0 & 0x10000000000000L) > 0L)

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2889	ognl		
2890	OgnlParserTokenManager		
2891	474	if ((active0 & 0x400000000L) != 0L)	if ((active0 & 0x400000000L) > 0L)
2892	ognl		
2893	OgnlParserTokenManager		
2894	488	if (((active0 &= old0)) == 0L)	if (((active0 &= old0)) <= 0L)
2895	ognl		
2896	OgnlParserTokenManager		
2897	500	if ((active0 & 0x800000000000L) != 0L)	if ((active0 & 0x800000000000L) > 0L)
2898	ognl		
2899	OgnlParserTokenManager		
2900	504	if ((active0 & 0x200000000000L) != 0L)	if ((active0 & 0x200000000000L) > 0L)
2901	ognl		
2902	OgnlParserTokenManager		
2903	508	if ((active0 & 0x400000000000L) != 0L)	if ((active0 & 0x400000000000L) > 0L)
2904	ognl		
2905	OgnlParserTokenManager		
2906	518	if (((active0 &= old0)) == 0L)	if (((active0 &= old0)) <= 0L)
2907	ognl		
2908	OgnlParserTokenManager		
2909	536	if (((active0 &= old0)) == 0L)	if (((active0 &= old0)) <= 0L)
2910	ognl		
2911	OgnlParserTokenManager		
2912	554	if (((active0 &= old0)) == 0L)	if (((active0 &= old0)) <= 0L)
2913	ognl		
2914	OgnlParserTokenManager		
2915	572	if (((active0 &= old0)) == 0L)	if (((active0 &= old0)) <= 0L)
2916	ognl		
2917	OgnlParserTokenManager		
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2985	ognl		
2986	OgnlParserTokenManager		
2987	590	if (((active0 &= old0)) == 0L)	if (((active0 &= old0)) <= 0L)
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3081	ognl OgnlParserTokenManager 741	if ((0x3ff000000000000L & 1) == 0L)	if ((0x3ff000000000000L & 1) <= 0L)	3129
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3093				3141
3094				3142
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3126				3174
3127				3175
3128				3176
	ognl OgnlParserTokenManager 748	if ((0x3ff000000000000L & 1) != 0L)	if ((0x3ff000000000000L & 1) > 0L)	
	ognl OgnlParserTokenManager 752	if ((0x2800000000000L & 1) != 0L)	if ((0x2800000000000L & 1) != -1L)	
	ognl OgnlParserTokenManager 756	if ((0x3ff000000000000L & 1) == 0L)	if ((0x3ff000000000000L & 1) <= 0L)	
	ognl OgnlParserTokenManager 763	if ((0x3ff000000000000L & 1) != 0L)	if ((0x3ff000000000000L & 1) > 0L)	
	ognl OgnlParserTokenManager 774	if ((0xff0000000000000L & 1) == 0L)	if ((0xff0000000000000L & 1) <= 0L)	
	ognl OgnlParserTokenManager 781	if ((0x3ff000000000000L & 1) == 0L)	if ((0x3ff000000000000L & 1) <= 0L)	
	ognl OgnlParserTokenManager 793	long l = 1L << (curChar & 077);	long l = 1L << (curChar & -1);	
	ognl OgnlParserTokenManager 799	if ((0x7fffffe87fffffeL & 1) != 0L)	if ((0x7fffffe87fffffeL & 1) > 0L)	

3177	ognl OgnlParserTokenManager 809	if ((0x7fffffe87fffffeL & 1) == 0L)	if ((0x7fffffe87fffffeL & 1) <= 0L)
3178			
3179	ognl OgnlParserTokenManager 820	if ((0x1000000040000000L & 1) != 0L)	if ((0x1000000040000000L & 1) > 0L)
3180			
3181			
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3184	ognl OgnlParserTokenManager 828	if ((0x110000001100L & 1) != 0L && kind > 80)	if ((0x110000001100L & 1) != 0L && kind > 1)
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	ognl OgnlParserTokenManager 832	if ((0x2000000020L & 1) != 0L)	if ((0x2000000020L & 1) > 0L)
	ognl OgnlParserTokenManager 836	if ((0x5400000054L & 1) != 0L && kind > 81)	if ((0x5400000054L & 1) != 0L && kind > 1)
	ognl OgnlParserTokenManager 840	if ((0x2000000020L & 1) != 0L)	if ((0x2000000020L & 1) > 0L)
	ognl OgnlParserTokenManager 844	if ((0x1000000010000000L & 1) != 0L)	if ((0x1000000010000000L & 1) > 0L)
	ognl OgnlParserTokenManager 848	if ((0x7e0000007eL & 1) == 0L)	if ((0x7e0000007eL & 1) <= 0L)
	ognl OgnlParserTokenManager 971	long l = 1L << (curChar & 077);	long l = 1L << (curChar & -1);

3273	ognl OgnlParserTokenManager 977	if ((0xffffffffffffffffL & 1) != 0L)	if ((0xffffffffffffffffL & 1) != 1L)
3274			
3275	ognl OgnlParserTokenManager 1072	if ((0xffffffffffffffffL & 1) != 0L && kind > 72)	if ((0xffffffffffffffffL & 1) != 0L && kind > 1)
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3282	ognl OgnlParserTokenManager 1076	if ((0x8400000000L & 1) != 0L && kind > 71)	if ((0x8400000000L & 1) !=1 && kind > 71)
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3369	ognl			3417
3370	OgnlParserTokenManager			3418
3371	1115	if ((0x14404510000000L & 1) != 0L && kind > 71)	if ((0x14404510000000L & 1) != 0L && kind > 1)	3419
3372				3420
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3414				3462
3415				3463
3416				3464
	ognl			
	OgnlParserTokenManager			
	1115	if ((0x14404510000000L & 1) != 0L && kind > 71)	if ((0x14404510000000L & 1) != 0L && kind > 1)	
	ognl			
	OgnlParserTokenManager			
	1129	int i1 = hiByte >> 6;	int i1 = hiByte >>= 6;	
	ognl			
	OgnlParserTokenManager			
	1130	long l1 = 1L << (hiByte & 077);	long l1 = 1L << (hiByte & -1);	
	ognl			
	OgnlParserTokenManager			
	1132	long l2 = 1L << (curChar & 077);	long l2 = 1L << (curChar & -1);	
	ognl			
	OgnlParserTokenManager			
	1201	if ((0xffffffffbfffffffffL & 1) != 0L && kind > 78)	if ((0xffffffffbfffffffffL & 1) != -1L && kind > 78)	
	ognl			
	OgnlParserTokenManager			
	1205	if ((0x8400000000L & 1) != 0L && kind > 77)	if ((0x8400000000L & 1) !=1 && kind > 77)	
	ognl			
	OgnlParserTokenManager			
	1209	if ((0xf00000000000L & 1) != 0L)	if ((0xf00000000000L & 1) > 0L)	
	ognl			
	OgnlParserTokenManager			
	1213	if ((0xff000000000000L & 1) == 0L)	if ((0xff000000000000L & 1) <= 0L)	

3465	ognl OgnlParserTokenManager 1220	if ((0xff000000000000L & 1) != 0L && kind > 77)	if ((0xff000000000000L 1) != 0L && kind > 77)	3513
3466				3514
3467	ognl OgnlParserTokenManager 1229	long l = 1L << (curChar & 077);	long l = 1L << (curChar & -1);	3515
3468				3516
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3471				3519
3472				3520
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3561	ognl OgnlParserTokenManager 1537	else if ((jjtoSkip[jjmatchedKind >> 6] & (1L << (jjmatchedKind & 077))) != 0L)	else if ((jjtoSkip[jjmatchedKind >> (6+1)] & (1L << (jjmatchedKind & 077))) != 0L)	3609
3562				3610
3563	ognl OgnlParserTokenManager 1529	if ((jjtoToken[jjmatchedKind >> 6] & (1L << (jjmatchedKind & 077))) != 0L)	if ((jjtoToken[jjmatchedKind >> 6] & (1L << (jjmatchedKind & 077))) > 0L)	3611
3564				3612
3565	ognl IntHashMap 177	int index = (key & 0x7FFFFFFF) % table.length;	int index = (key & 0x1FFFFFFF) % table.length;	3613
3566				3614
3567	ognl IntHashMap 201	int index = (key & 0x7FFFFFFF) % table.length;	int index = (key & 0x1FFFFFFF) % table.length;	3615
3568				3616
3569	ognl JavaCharStream 300	if ((c == 'u') && ((backSlashCnt & 1) == 1))	if ((c == 'u') && ((backSlashCnt 1) == 1))	3617
3570				3618
3571	ognl DefaultClassResolver 61	if (className.indexOf('.') > -1) {	if (className.indexOf('.')!= -1) {	3619
3572				3620
3573	ognl ASTAdd 226	if (expr.indexOf('\') >= 0)	if (expr.indexOf('\') == 0)	3621
3574				3622
3575	ognl ASTAdd 244	if (expr.indexOf("";") >= 0)	if (expr.indexOf("";") >= 1)	3623
3576				3624
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ognl OgnlParser 3206	if ((jj_la1_0[i] & (1<<j)) != 0) {	if ((jj_la1_0[i] & (1<<j)) > 0) {
ognl OgnlParser 3209	if ((jj_la1_1[i] & (1<<j)) != 0) {	if ((jj_la1_1[i] & (1<<j)) > 0) {
ognl OgnlParser 3212	if ((jj_la1_2[i] & (1<<j)) != 0) {	if ((jj_la1_2[i] & (1<<j)) > 0) {
ognl ExpressionCompiler 549	if (body.indexOf("..") >= 0)	if (body.indexOf("..") >= (0+1))
ognl ExpressionCompiler 590	if (body.indexOf("..") >= 0)	if (body.indexOf("..") >= (0+1))
ognl ExpressionCompiler 639	if (body.indexOf("..") >= 0)	if (body.indexOf("..") >= (0+1))

REFERENCES

[1] Pengyu Nie, Rahul Banerjee, Junyi Jessie Li, Raymond J. Mooney, and Milos Gligoric. 2023. Learning deep semantics for test completion. In *ICSE*. 1–12.