

	Fix pattern	Calculated cluster	TBar cluster		TBar FP
1	Replace an operator Change: (OPERATOR) to (OPERATOR)	<b>cha-1</b> , <b>clo-62</b> , <b>clo-73</b> , com-19, jaC-14 <sub>1,2</sub> , jaC-25, - <b>mat-65</b> <sub>1</sub> , <b>mat-82</b> , <b>mat-85</b> , <b>tim-19</b>	<b>cha-1</b> , <b>clo-38</b> , clo-62, <b>clo-63</b> , clo-73, - <b>lan-22</b> , <b>mat-65</b> , mat-82, mat-85, <b>tim-19</b>		FP11.1
2	Replace a primitive type Change: (PRIMITIVE_TYPE) to (PRIMITIVE_TYPE)	<b>mat-30</b> , <b>mat-57</b> , <b>mat-79</b>	<b>mat-30</b> , <b>mat-57</b> , <b>mat-79</b>		FP7.1
3	Replace a method invocation Change: (METHOD_INVOCATION, IDENTIFIER) to (METHOD_INVOCATION, IDENTIFIER)	cli-1 <sub>1</sub> , cli-18 <sub>1</sub> , cli-27, cli-33, cli-39, <b>clo-4</b> , <b>clo-10</b> , clo-27 <sub>1,2</sub> , clo-30, clo-74, clo-79 <sub>1</sub> , clo-92, com-32, jaD-31 <sub>1..17</sub> , jaD-82, jaD-96, jaD-97, jaD-103 <sub>1..22</sub> , jaD-108, jso-3 <sub>1..3</sub> , jso-12, jso-23, jso-61, jso-62, jso-77, jso-86, jso-87 <sub>1..13</sub> , jso-92 <sub>1</sub> , jxP-10, <b>mat-75</b> , mat-83 <sub>1</sub> , mat-100 <sub>1,2</sub> , moc-21 <sub>1</sub>	- <b>clo-4</b> , clo-10, - - - - <b>mat-75</b>		FP10.1
4	Replace a variable Change: (IDENTIFIER) to (IDENTIFIER)	<b>cha-7</b> , <b>cha-8</b> , <b>cha-11</b> , <b>cha-24</b> , cli-7, cli-36 <sub>1,2</sub> , clo-14, clo-75, clo-149 <sub>1</sub> , com-42 <sub>1</sub> , jaD-34, jaD-37, jaD-54, jso-66 <sub>1</sub> , <b>lan-6</b> , <b>lan-21</b> , <b>lan-59</b> , lan-60 <sub>1,2</sub> , <b>mat-5</b> , mat-15 <sub>1</sub> , <b>mat-33</b> , mat-49 <sub>1..4</sub> , <b>mat-59</b> , mat-72, <b>mat-98</b> <sub>1,2</sub> , moc-5 -	<b>cha-7</b> , <b>cha-8</b> , <b>cha-11</b> , <b>cha-24</b> , - - <b>lan-6</b> , <b>lan-59</b> , <b>mat-5</b> , <b>mat-33</b> , <b>mat-59</b> , <b>mat-98</b> , - <b>tim-7</b>		FP13.1
5	Replace 2 variables Change: (IDENTIFIER, IDENTIFIER) to (IDENTIFIER, IDENTIFIER)	<b>cha-20</b>	<b>cha-20</b>		FP10.2
6	Replace an assignment with a method invoc. Change: (ASSIGNMENT, IDENTIFIER) to (METHOD_INVOCATION, IDENTIFIER)	<b>cha-12</b> , <b>mat-35</b> <sub>1,2</sub>	<b>cha-12</b> , <b>mat-35</b>		FP4.1
7	Replace a constant Change: (LITERAL) to (LITERAL)	<b>clo-70</b> , <b>clo-86</b> , clo-168, <b>cod-3</b> , cod-4, cod-7, <b>mat-22</b> <sub>1,2</sub> , mat-81 <sub>1</sub> , mat-104, <b>moc-26</b>	<b>clo-40</b> , clo-70, clo-86, - <b>mat-22</b> , <b>moc-26</b>		FP9.1
8	Replace a constant and operands Change: (OPERATOR) to (OPERATOR), Insert: (INSERT_BLOCK)), Delete: (DELETE_BLOCK)	<b>mat-11</b>	<b>mat-11</b>		FP8.3
9	Remove a method Delete: (METHOD, DELETE_BLOCK)	cli-18 <sub>2</sub> , cli-22 <sub>1..3</sub> , clo-3 <sub>1,2</sub> , clo-16 <sub>1,2</sub> , <b>clo-46</b> , clo-51 <sub>1</sub> , clo-64 <sub>1,2</sub> , clo-137 <sub>1..11</sub> , clo-148 <sub>1..39</sub> , clo-153 <sub>1..12</sub> , clo-155 <sub>1,2</sub> , clo-156 <sub>1..11</sub> , clo-158 <sub>1..5</sub> , clo-163 <sub>1..27</sub> , clo-165 <sub>1..4</sub> , clo-167 <sub>1..3</sub> , clo-169 <sub>1..24</sub> , clo-175 <sub>1..5</sub> , cod-8 <sub>1</sub> , com-43 <sub>1</sub> , csv-16 <sub>1</sub> , gso-4 <sub>1,2</sub> , jaD-10 <sub>1..3</sub> , jaD-22 <sub>1..10</sub> , jaD-75 <sub>1..3</sub> , jso-3 <sub>4</sub> , jso-30 <sub>1..7</sub> , jso-63 <sub>1</sub> , jso-66 <sub>2,3</sub> , jxP-4 <sub>1..3</sub> , jxP-7 <sub>1..4</sub> , jxP-9 <sub>1..3</sub> , jxP-13 <sub>1..5</sub> , lan-30 <sub>1..4</sub> , lan-32 <sub>1,2</sub> , lan-46 <sub>1..5</sub> , lan-63 <sub>1</sub> , mat-66 <sub>1..9</sub> , <b>mat-77</b> , mat-90, moc-10 <sub>1..4</sub> , moc-16 <sub>1..2</sub> , moc-19 <sub>1..8</sub> , moc-21 <sub>2..4</sub> , moc-25 <sub>1..3</sub> , moc-30 <sub>1,2</sub>	- <b>clo-46</b> , - - - - - - - - <b>mat-77</b> - -		FP15.2
10	Remove a block Delete: (DELETE_BLOCK)	<b>cha-18</b> <sub>1</sub> , cli-1 <sub>2,3</sub> , cli-19, cli-25, cli-31 <sub>1</sub> , cli-32, <b>clo-6</b> <sub>1,2</sub> , clo-9 <sub>1</sub> , <b>clo-11</b> , <b>clo-18</b> , <b>clo-31</b> , clo-49 <sub>1</sub> , clo-54 <sub>1</sub> , clo-78, <b>clo-85</b> <sub>1</sub> , clo-89 <sub>1</sub> , <b>clo-106</b> <sub>1</sub> , <b>clo-115</b> , <b>clo-126</b> , clo-134 <sub>1</sub> , clo-136 <sub>1</sub> , clo-138 <sub>1</sub> , clo-140 <sub>1</sub> , clo-148 <sub>40</sub> , clo-149 <sub>2,3</sub> , clo-153 <sub>13,14</sub> , clo-154 <sub>1,2</sub> , clo-169 <sub>25</sub> , clo-173 <sub>1</sub> , cod-8 <sub>2</sub> , cod-16, com-4 <sub>1,2</sub> , com-9, com-22 <sub>1..6</sub> , com-27, com-31, csv-8 <sub>1</sub> , csv-15, gso-4 <sub>3..11</sub> , gso-9 <sub>1,2</sub> , jaC-2, jaC-5, jaD-83, jaD-102, jso-4 <sub>1,2</sub> , jso-18, jso-21, jso-24, jso-40, jso-52 <sub>1</sub> , jso-63 <sub>2..4</sub> , jso-68, <b>lan-7</b> <sub>1</sub> , lan-8 <sub>1,2</sub> , <b>lan-10</b> , <b>lan-15</b> <sub>1</sub> , lan-34 <sub>1</sub> , mat-18 <sub>1,2</sub> , mat-46 <sub>1,2</sub> , <b>mat-50</b> , mat-58, moc-23 <sub>1</sub> , tim-1 <sub>1</sub> , tim-2 <sub>1</sub>	<b>cha-18</b> , <b>clo-6</b> , clo-11, <b>clo-21</b> , <b>clo-22</b> , <b>clo-85</b> , <b>clo-106</b> , <b>clo-115</b> , <b>clo-126</b> , - - - - - - <b>lan-7</b> , <b>lan-10</b> , <b>lan-63</b> , <b>mat-50</b> -	- <b>clo-18</b> , <b>clo-31</b> , - - - - - - - <b>lan-15</b> - -	FP15.1   FP6.2

Table 1: Calculated clusters (with the fix patterns of their centroids) with *replace* and *remove* actions and their matching TBar clusters.

	Fix pattern	Calculated cluster	TBar cluster	TBar FP
11	Move code Delete: (MOVE_BLOCK), Insert: (MOVE_BLOCK)	<b>clo-13, clo-102</b> , clo-137 <sub>12</sub> , clo-156 <sub>12</sub> , jso-64, jxP-20, lan-4 <sub>1</sub> , mat-86, tim-4, <u>tim-7</u>	<b>clo-13, clo-102</b> - - - -	FP14
12	Insert a parameter Insert: (IDENTIFIER)	cli-34 <sub>1</sub> clo-37 <sub>1</sub> , clo-144 <sub>1</sub> , clo-165 <sub>5</sub> , clo-175 <sub>6</sub> , cod-1 <sub>1,3</sub> , cod-13, com-43 <sub>2,3</sub> jaD-52, jaD-75 <sub>4</sub> , jaD-105 <sub>1</sub> jso-66 <sub>4,5</sub> , <b>lan-26</b> , <b>mat-70</b> , moc-19 <sub>9</sub> , moc-25 <sub>4</sub> , moc-30 <sub>3</sub> , <b>tim-26</b> <sub>1..8</sub>	- - - - - <b>lan-26</b> , <b>mat-70</b> , - <b>tim-26</b>	FP6.3
13	Insert a return statement Insert: (RETURN, LITERAL)	<u>lan-51</u>	<b>lan-51</b>	FP4.2
14	Insert parentheses to change the order of operations Delete: (BLOCK), Insert: (PARENTHESIZED, OPERATOR)	<u>mat-80</u>	<b>mat-80</b>	FP11.2
15	Insert a method invocation Insert: (METHOD_INVOCATION, IDENTIFIER)	jso-73 <sub>1</sub> , <b>lan-57</b> , <u>mat-34</u> , mat-65 <sub>2</sub>	- <b>lan-57</b> , <b>mat-34</b>	FP13.2
16	Insert a condition Insert: (OPERATOR, PARENTHESIZED)), Insert: (PARENTHESIZED, OPERATOR, IDENTIFIER, IDENTIFIER)	<u>cha-9</u> -	<b>cha-9</b> , <u>mat-15</u>	FP6.3
17	Insert an if statement Insert: IF, PARENTHESIZED, OPERATOR, IDENTIFIER, LITERAL, BLOCK	com-11, gso-12, lan-3, mat-95 <u>tim-3</u> <sub>1..10</sub>	- - - - <b>tim-3</b>	FP4.4
18	Insert an if block Insert: (IF, PARENTHESIZED, OPERATOR, IDENTIFIER, NULL_LITERAL, BLOCK, EXPRESSION_STATEMENT, ASSIGNMENT, IDENTIFIER, LITERAL)	<u>lan-47</u> <sub>1,2</sub>	<b>lan-47</b>	FP2.3
19	Insert a null pointer checker Insert: (IF, PARENTHESIZED, OPERATOR, IDENTIFIER, NULL_LITERAL, BLOCK)	<b>cha-4</b> , cha-15 <sub>1</sub> , <b>cha-26</b> , csv-5, gso-6 jaD-15 <sub>1</sub> , jaD-49, <u>jaD-80</u> <sub>1,2</sub> - -	<b>cha-4, cha-26</b> , - - - <u>clo-2</u> , <u>lan-33</u> , <u>lan-39</u>	FP2.1
20	Insert a null pointer checker with return Insert: (IF, PARENTHESIZED, OPERATOR, IDENTIFIER, NULL_LITERAL, BLOCK, RETURN, LITERAL)	<u>cha-14</u> <sub>1..4</sub> , cha-15 <sub>2</sub> -	<b>cha-14</b> , <u>moc-29</u> , <u>moc-38</u>	FP2.2
21	Insert a null pointer checker with throwing an exception Insert: (IF, PARENTHESIZED, OPERATOR, IDENTIFIER, NULL_LITERAL, BLOCK, THROW, NEW_CLASS, IDENTIFIER, LITERAL)	<u>cha-19</u> <sub>1,2</sub>	<b>cha-19</b>	FP2.5
22	Insert if-else with throwing an exception Insert: (IF, PARENTHESIZED, INSTANCE_OF, IDENTIFIER, PARAMETERIZED_TYPE, IDENTIFIER, UNBOUNDED_WILDCARD, BLOCK), Insert: (BLOCK, THROW, NEW_CLASS, IDENTIFIER, LITERAL)	<u>mat-89</u>	<b>mat-89</b>	FP1

Table 2: Calculated clusters (with the fix patterns of their centroids) with *move* and *insert* actions and their matching TBar clusters.