

	Fix pattern	Calculated clusters	TBar clusters		TBar FP
1	Replace an operator Change: (OPERATOR) to (OPERATOR)	cha-1 , clo-62 , clo-73 , com-19, jaC-14 _{1,2} , jaC-25, - mat-65 ₁ , mat-82 , mat-85 , tim-19	cha-1 , clo-38 , clo-62 , clo-63 , clo-73 , - lan-22 , mat-65 , mat-82 , mat-85 , tim-19		FP11.1
2	Replace a primitive type Change: (PRIMITIVE_TYPE) to (PRIMITIVE_TYPE)	mat-30 , mat-57 , mat-79	mat-30 , mat-57 , mat-79		FP7.1
3	Replace a method invocation Change: (METHOD_INVOCATION, IDENTIFIER) to (METHOD_INVOCATION, IDENTIFIER)	cli-1 ₁ , cli-18 ₁ , cli-27, cli-33, cli-39, clo-4 , clo-10 , clo-27 _{1,2} , clo-30, clo-74, clo-79 ₁ , clo-92, com-32, jaD-31 _{1..17} , jaD-82, jaD-96, jaD-97, jaD-103 _{1..22} , jaD-108, jso-3 _{1..3} , jso-12, jso-23, jso-61, jso-62, jso-77, jso-86, jso-87 _{1..13} , jso-92 ₁ , jxP-10, mat-75 , mat-83 ₁ , mat-100 _{1,2} , moc-21 ₁	- clo-4 , clo-10 , - - - - mat-75		FP10.1
4	Replace a variable Change: (IDENTIFIER) to (IDENTIFIER)	cha-7 , cha-8 , cha-11 , cha-24 , cli-7, cli-36 _{1,2} , clo-14, clo-75, clo-149 ₁ , com-42 ₁ , jaD-34, jaD-37, jaD-54, jso-66 ₁ , lan-6 , lan-21 , lan-59 , lan-60 _{1,2} , mat-5 , mat-15 ₁ , mat-33 , mat-49 _{1..4} , mat-59 , mat-72, mat-98 _{1,2} , moc-5 -	cha-7 , cha-8 , cha-11 , cha-24 , - - lan-6 , lan-59 , mat-5 , mat-33 , mat-59 , mat-98 , - tim-7		FP13.1
5	Replace 2 variables Change: (IDENTIFIER, IDENTIFIER) to (IDENTIFIER, IDENTIFIER)	cha-20	cha-20		FP10.2
6	Replace an assignment with a method invoc. Change: (ASSIGNMENT, IDENTIFIER) to (METHOD_INVOCATION, IDENTIFIER)	cha-12 , mat-35 _{1,2}	cha-12 , mat-35		FP4.1
7	Replace a constant Change: (LITERAL) to (LITERAL)	clo-70 , clo-86 , clo-168, cod-3, cod-4, cod-7, mat-22 _{1,2} , mat-81 ₁ , mat-104, moc-26	clo-40 , clo-70 , clo-86 , - mat-22 , moc-26		FP9.1
8	Replace a constant and operands Change: (OPERATOR) to (OPERATOR), Insert: (INSERT_BLOCK)), Delete: (DELETE_BLOCK)	mat-11	mat-11		FP8.3
9	Remove a method Delete: (METHOD, DELETE_BLOCK)	cli-18 ₂ , cli-22 _{1..3} , clo-3 _{1,2} , clo-16 _{1,2} , clo-46 , clo-51 ₁ , clo-64 _{1,2} , clo-137 _{1..11} , clo-148 _{1..39} , clo-153 _{1..12} , clo-155 _{1,2} , clo-156 _{1..11} , clo-158 _{1..5} , clo-163 _{1..27} , clo-165 _{1..4} , clo-167 _{1..3} , clo-169 _{1..24} , clo-175 _{1..5} , cod-8 ₁ , com-43 ₁ , csv-16 ₁ , gso-4 _{1,2} , jaD-10 _{1..3} , jaD-22 _{1..10} , jaD-75 _{1..3} , jso-3 ₄ , jso-30 _{1..7} , jso-63 ₁ , jso-66 _{2,3} , jxP-4 _{1..3} , jxP-7 _{1..4} , jxP-9 _{1..3} , jxP-13 _{1..5} , lan-30 _{1..4} , lan-32 _{1,2} , lan-46 _{1..5} , lan-63 ₁ , mat-66 _{1..9} , mat-77 , mat-90, moc-10 _{1..4} , moc-16 _{1..2} , moc-19 _{1..8} , moc-21 _{2..4} , moc-25 _{1..3} , moc-30 _{1,2}	- clo-46 , - - - - - - - - mat-77 - -		FP15.2
10	Remove a block Delete: (DELETE_BLOCK)	cha-18 ₁ , cli-1 _{2,3} , cli-19, cli-25, cli-31 ₁ , cli-32, clo-6 _{1,2} , clo-9 ₁ , clo-11 , clo-18 , clo-31 , clo-49 ₁ , clo-54 ₁ , clo-78, clo-85 ₁ , clo-89 ₁ , clo-106 ₁ , clo-115 , clo-126 , clo-134 ₁ , clo-136 ₁ , clo-138 ₁ , clo-140 ₁ , clo-148 ₄₀ , clo-149 _{2,3} , clo-153 _{13,14} , clo-154 _{1,2} , clo-169 ₂₅ , clo-173 ₁ , cod-8 ₂ , cod-16, com-4 _{1,2} , com-9, com-22 _{1..6} , com-27, com-31, csv-8 ₁ , csv-15, gso-4 _{3..11} , gso-9 _{1,2} , jaC-2, jaC-5, jaD-83, jaD-102, jso-4 _{1,2} , jso-18, jso-21, jso-24, jso-40, jso-52 ₁ , jso-63 _{2..4} , jso-68, lan-7 ₁ , lan-8 _{1,2} , lan-10 , lan-15 ₁ , lan-34 ₁ , mat-18 _{1,2} , mat-46 _{1,2} , mat-50 , mat-58, moc-23 ₁ , tim-1 ₁ , tim-2 ₁	cha-18 , clo-6 , clo-11 , clo-21 , clo-22 , clo-85 , clo-106 , clo-115 , clo-126 , - - - - - - lan-7 , lan-10 , lan-63 , mat-50 -	- clo-18 , clo-31 , - - - - - - - lan-15 - -	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 clusters	TBar clusters	TBar FP
11	Move code Delete: (MOVE_BLOCK), Insert: (MOVE_BLOCK)	clo-13, clo-102 , clo-137 ₁₂ , clo-156 ₁₂ , jso-64, jxP-20, lan-4 ₁ , mat-86, tim-4, <u>tim-7</u>	clo-13, clo-102 - - - -	FP14
12	Insert a parameter Insert: (IDENTIFIER)	cli-34 ₁ clo-37 ₁ , clo-144 ₁ , clo-165 ₅ , clo-175 ₆ , cod-1 _{1,3} , cod-13, com-43 _{2,3} jaD-52, jaD-75 ₄ , jaD-105 ₁ jso-66 _{4,5} , lan-26 , mat-70 , moc-19 ₉ , moc-25 ₄ , moc-30 ₃ , tim-26 _{1..8}	- - - - - lan-26 , mat-70 , - tim-26	FP6.3
13	Insert a return statement Insert: (RETURN, LITERAL)	<u>lan-51</u>	lan-51	FP4.2
14	Insert parentheses to change the order of operations Delete: (BLOCK), Insert: (PARENTHESIZED, OPERATOR)	<u>mat-80</u>	mat-80	FP11.2
15	Insert a method invocation Insert: (METHOD_INVOCATION, IDENTIFIER)	jso-73 ₁ , lan-57 , <u>mat-34</u> , mat-65 ₂	- lan-57 , mat-34	FP13.2
16	Insert a condition Insert: (OPERATOR, PARENTHESIZED)), Insert: (PARENTHESIZED, OPERATOR, IDENTIFIER, IDENTIFIER)	<u>cha-9</u> -	cha-9 , <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> _{1..10}	- - - - tim-3	FP4.4
18	Insert an if block Insert: (IF, PARENTHESIZED, OPERATOR, IDENTIFIER, NULL_LITERAL, BLOCK, EXPRESSION_STATEMENT, ASSIGNMENT, IDENTIFIER, LITERAL)	<u>lan-47</u> _{1,2}	lan-47	FP2.3
19	Insert a null pointer checker Insert: (IF, PARENTHESIZED, OPERATOR, IDENTIFIER, NULL_LITERAL, BLOCK)	cha-4 , cha-15 ₁ , cha-26 , csv-5, gso-6 jaD-15 ₁ , jaD-49, <u>jaD-80</u> _{1,2} - -	cha-4, cha-26 , - - - <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> _{1..4} , cha-15 ₂ -	cha-14 , <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> _{1,2}	cha-19	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>	mat-89	FP1

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