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Supplementary materials for

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```
public class Order {

    private static String orderNO;
    private static String orderStatus;
    private static Goods goods;
    private static String address;

    public Order() {
        setOrderNO(new Date().toString()); }
    public static String getOrderNO() {
        return orderNO; }
    public void setOrderNO(String orderNO) {
        this.orderNO = orderNO; }
    public static String getOrderStatus() {
        return orderStatus;}
    public void setOrderStatus(String orderStatus) {
        this.orderStatus = orderStatus; }
    public static Goods getGoods() {
        return goods; }
    public void setGoods(Goods goods) {
        this.goods = goods; }
    public static String getAddress() {
        return address; }
    public void setAddress(String address) {
        this.address = address; }
}

public class InitializeMenu {
    public static void main(String[] args) {
        initialize();
    }
    private static void initialize() {
        OrderService submitOrderService =
        new OrderService();
        Distribution distributeService =
        new Distribution();
        Store storeInfo = new Store();
    }
}

public class Distribution {

    OrderService orderService = new OrderService();
    public void distributeOrder(String orderNO) {
    orderService.updateOrderStatus_Distribution(
    orderNO);
    }
}
```

```
public class OrderService {

public static ArrayList<Order> orders = new ArrayList<>();
public void buy(Goods goods, String address) {
    Order newOrder = addOrder(goods, address);
    if(newOrder != null){
    payOrder(newOrder.getOrderNO());
    }
}
private Order addOrder(Goods goods, String address) {
    if (Store.hasGoods(goods.getGoodsNO())) {
    Order newOrder = new Order();
    newOrder.setGoods(goods);
    newOrder.setOrderStatus("Pending Payment");
    newOrder.setAddress(address);
    orders.add(newOrder);
    return newOrder;
    }
    return null;
}
public void updateOrderStatus_Pay(String orderNO) {
    for (Order orderTemp : orders) {
    if (orderTemp.getOrderNO().equals(orderNO)) {
    orderTemp.setOrderStatus("Payment Completion"); }
                }
}
public void updateOrderStatus_Distribution(String orderNO) {
    for (Order orderTemp : orders) {
    if (orderTemp.getOrderNO().equals(orderNO)) {
    orderTemp.setOrderStatus("Successfully Delivered");
            }
    }

}
public boolean payOrder(String orderNO) {
    updateOrderStatus_Pay(orderNO);
    return true;
}
public void ShowOrderDetails(Order OrderTemp){
    System.out.println("Order ID: " +
    OrderTemp.getOrderNO() +
    "Goods ID:" + OrderTemp.getOrderNO() +
    "Address:" + OrderTemp.getAddress() +
    "Order Status:" + OrderTemp.getOrderStatus() +
    "Comments:" + OrderTemp.getGoods().getComments()
                                    );
}
}
```

```
public class Store {

    static Map<String, Goods> list =
    new HashMap();
    public static boolean hasGoods(String
    goodsID) {
        if(queryList(goodsID) != null){
            return true;
        } else {
            return false;
        }
    }
    static Goods queryList(String goodsID){
        if(list.containsKey(goodsID)){
            return list.get(goodsID);
        } else {
            return null;
        }
    }
}

public class Goods {

    private static String goodsName;
    private static String goodsNO;
    private String comments;
    public static String getGoodsNO() {
        return goodsNO;
    }
    public static String getGoodsName() {
        return goodsName;
    }
    public String getComments() {
        return comments;
    }
    public void setComments(String comments) {
        this.comments = comments;
    }
    public void SubmitGoodsComments(String
    ServiceScore, String GoodsScore, Order order){
        Goods goods = order.getGoods();
        String comments = ServiceScore + " "
        + GoodsScore;
        goods.setComments(comments);
        OrderService.orders.add(order);
    }
}
```

Fig. S1 Sample code illustrating the proposed MDEN model

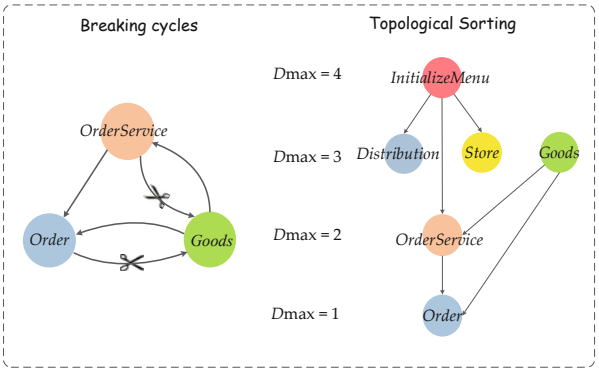
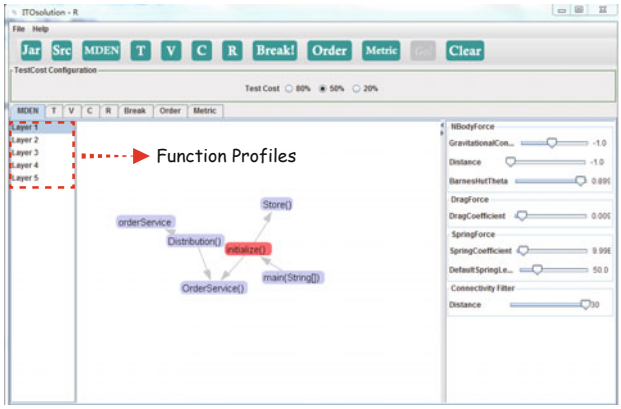
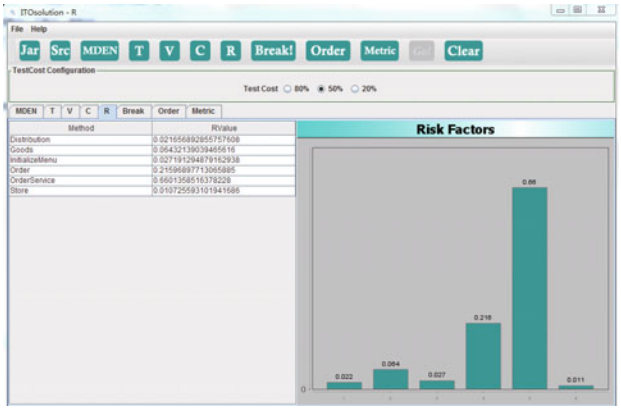


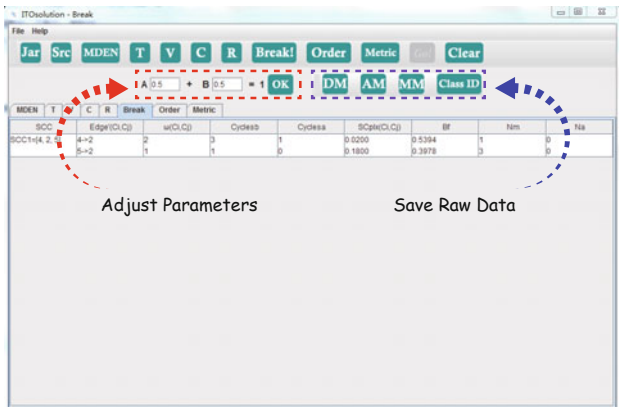
Fig. S2 Generating an integration test order process



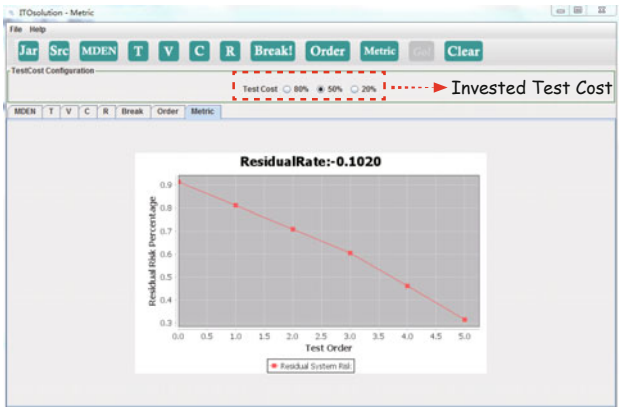
(a) The MDEN model mapped from the example code



(b) The risk distribution diagram of the example code

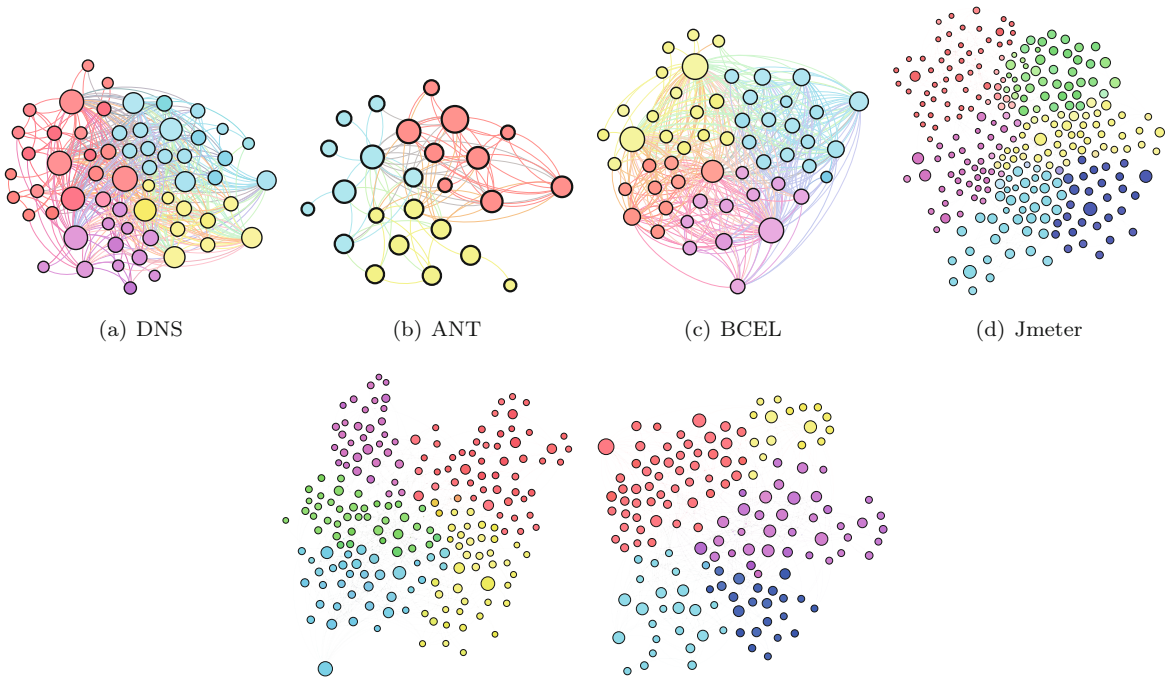


(c) The tooltip of breaking cycle operation



(d) The software risk reduction curve due to the integration steps

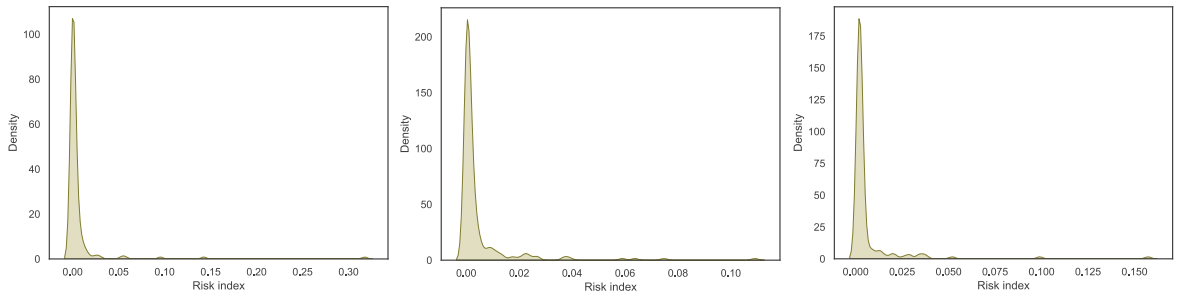
Fig. S3 Main features of our tool ITOsolution



(a) DNS (b) ANT (c) BCEL (d) Jmeter

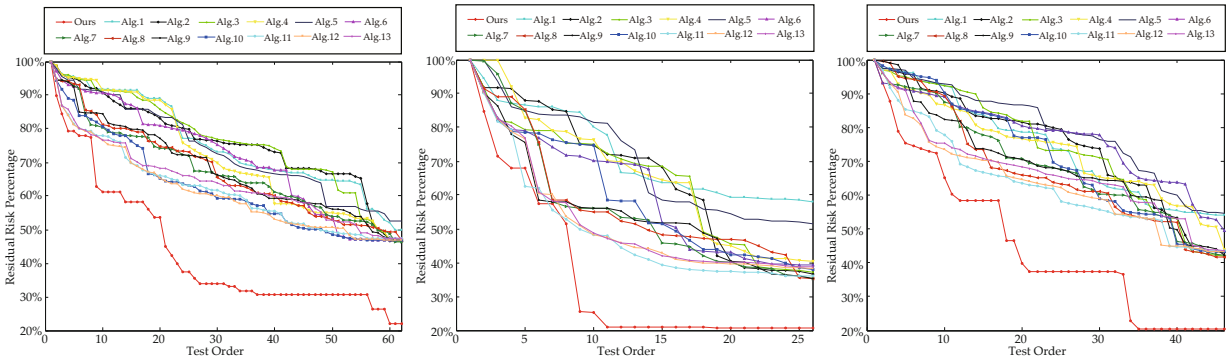
(e) Xml-security (f) Joda-time

Fig. S4 Class-level dependency networks of the subjects

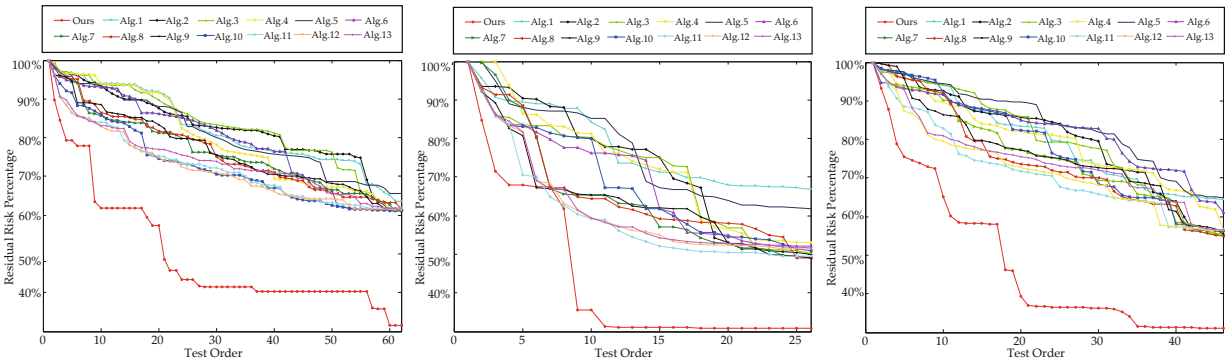


(a) $\mathcal{R}(C_i)$ distribution of Jmeter (b) $\mathcal{R}(C_i)$ distribution of Xml-security (c) $\mathcal{R}(C_i)$ distribution of Joda-time

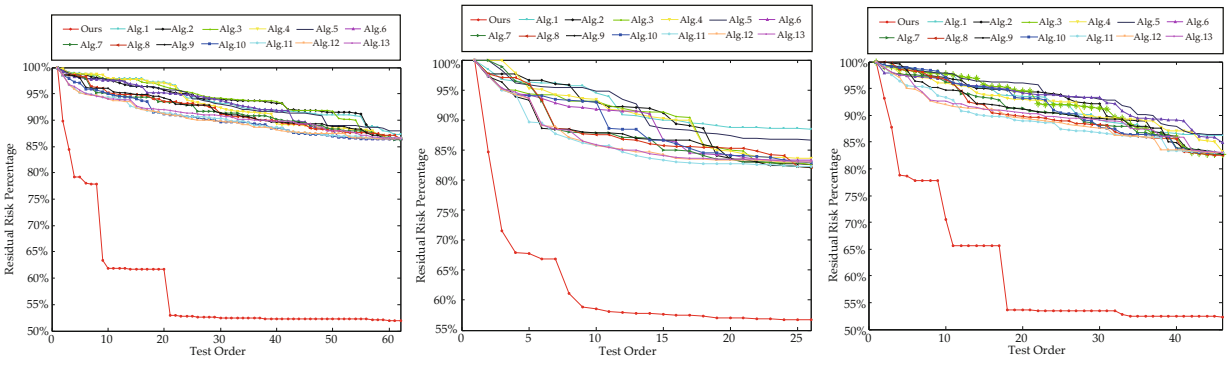
Fig. S5 Class risk probability density distribution



(a) Reduction in total risk of DNS (θ = 80%) (b) Reduction in total risk of ANT (θ = 80%) (c) Reduction in total risk of BCEL (θ = 80%)



(d) Reduction in total risk of DNS (θ = 50%) (e) Reduction in total risk of ANT (θ = 50%) (f) Reduction in total risk of BCEL (θ = 50%)



(g) Reduction in total risk of DNS (θ = 20%) (h) Reduction in total risk of ANT (θ = 20%) (i) Reduction in total risk of BCEL (θ = 20%)

Fig. S6 Comparison of the reduction in total risk indices
Alg.1 = Tai and Daniels (1999)'s, Alg.2 = Abdurazik and Offutt (2006)'s, Alg.3 = Briand et al. (2002)'s, Alg.4 = Briand et al. (2003)'s, Alg.5 = Le Traon et al. (2000)'s, Alg.6 = Jiang et al. (2011)'s, Alg.7 = NSGA-II in Assunção et al. (2014), Alg.8 = PAES in Assunção et al. (2014), Alg.9 = SPEA2 in Assunção et al. (2014), Alg.10 = Risk-based GA, Alg.11 = Risk-based NSGA-II, Alg.12 = Risk-based PAES, and Alg.13 = Risk-based SPEA2

Table S1 Statistics of the top and bottom five nodes

Software	Rank	No.	VL_i	$\mathcal{B}_i$	K_{out}	MPC_{out}	K_{in}	MPC_{in}	WMC	LOC	$\mathcal{T}(C_i)$	$\mathcal{V}(C_i)$	$\mathcal{C}(C_i)$	$\mathcal{R}(C_i)$
Jmeter	1	258	8578.19	2.85	1	46	2	48	106.05	244	0.0121	0.0109	0.0382	0.1509
	2	272	3109.69	1.04	0	0	6	43	27.02	617	0.0224	0.0291	0.0066	0.1279
	3	264	2750.97	0.92	3	30	1	27	10.97	259	0.0114	0.0101	0.0216	0.0746
	4	109	6149.07	2.05	9	70	12	73	31.73	500	0.0143	0.0163	0.0102	0.0709
	5	73	1673.47	0.56	3	23	9	49	8.48	193	0.0076	0.0096	0.0170	0.0371
	281	192	2.00	0.00	0	0	2	2	0	16	2.23E-4	3.29E-6	2.77E-4	6.08E-9
	282	208	3.00	0.00	0	0	1	5	1	15	8.95E-4	3.29E-6	4.57E-5	4.02E-9
	283	44	2.00	0.00	0	0	3	3	2	18	6.73E-4	3.29E-6	3.04E-5	2.01E-9
	284	199	2.00	0.00	0	0	1	1	0	9	2.24E-4	3.29E-6	3.04E-5	6.70E-10
	285	209	2.00	0.00	0	0	1	1	0	13	2.24E-4	3.29E-6	3.04E-5	6.70E-10
Xml-security	1	66	2164.19	0.72	1	28	46	191	20.04	242	0.0167	0.0164	0.0125	0.1091
	2	34	3169.89	1.06	4	33	12	105	21	322	0.0207	0.0132	0.0086	0.0747
	3	210	13,219.66	4.41	11	55	77	237	161.21	1052	0.0109	0.0212	0.0087	0.0637
	4	201	3727.91	1.24	1	20	13	30	26	333	0.0157	0.0111	0.0107	0.0590
	5	39	5089.31	1.70	3	11	3	19	2	369	0.0127	0.0193	0.0050	0.0392
	215	79	934.04	0.31	0	0	1	1	0	82	3.64E-4	0.0014	7.14E-5	1.17E-6
	216	63	896.92	0.30	1	1	0	0	0	72	3.64E-4	0.0013	7.14E-5	1.12E-6
	217	70	896.92	0.30	1	1	0	0	0	67	3.64E-4	0.0013	7.14E-5	1.12E-6
	218	83	896.92	0.30	0	0	1	1	0	67	3.64E-4	0.0013	7.14E-5	1.12E-6
	219	169	2.00	0.00	1	1	0	0	0	7	3.64E-4	1.82E-5	7.14E-5	1.50E-8
Joda-time	1	144	34,722.17	11.57	1	78	2	162	28.05	1990	3.96E-6	0.0321	0.1228	0.1573
	2	5	985.93	0.33	0	0	45	425	3	36	1.49E-5	0.0365	0.0180	0.0990
	3	11	2588.31	0.86	1	29	28	250	19.08	162	2.60E-5	0.0182	0.0109	0.0519
	4	111	3246.06	1.08	2	7	51	166	54.06	322	5.51E-6	0.0152	0.0447	0.0377
	5	134	907.42	0.30	1	13	3	13	11	78	2.44E-5	0.0140	0.0107	0.0368
	152	13	675.42	0.23	3	4	2	4	7	80	8.02E-5	0.0013	0.0017	0.0017
	153	147	2797.88	0.93	1	26	1	5	2	182	1.71-4	5.88E-4	0.0017	0.0017
	154	149	3552.55	1.18	1	13	1	7	3.13	142	3.03E-4	0.0067	8.32E-5	0.0017
	155	153	376.42	0.13	1	3	1	3	3.99	153	1.23E-4	7.11E-4	0.0019	0.0017
	156	155	332.11	0.11	0	3	1	6	3	36	0.0609	6.27E-4	4.42E-6	0.0017

VL_i: code volume; $\mathcal{B}_i$: number of faults; K_{out}: out-degree; MPC_{out}: total number of dependencies of class C_i methods on methods not belonging to class C_i; K_{in}: in-degree; MPC_{in}: total number of times that the methods of class C_i were invoked by methods not belonging to class C_i; WMC (structural complexity): sum of McCabe's cyclomatic complexity metric values of the methods in class C_i; LOC: lines of code; $\mathcal{T}(C_i)$: probability of code within class C_i being executed dynamically; $\mathcal{V}(C_i)$: complexity of class C_i; $\mathcal{C}(C_i)$: failure consequence of class C_i; $\mathcal{R}(C_i) = \mathcal{T}(C_i) \times \mathcal{V}(C_i) \times \mathcal{C}(C_i)$

Table S2 Compared test case prioritization techniques

Label	Prioritization	Description
T1	Untreated	Original ordering of test cases
T2	Random	Test cases are ordered randomly
T3	Optimal	Test cases are ordered to maximize the rate of severe fault detection
T4	Total methods coverage	The test case with the higher number of covered methods has higher priority
T5	Additional methods coverage	Test cases are prioritized by the number of covered methods not yet covered by the executed ones
T6	Different methods coverage	Test cases are prioritized based on the number of covered methods which differ from those methods in the previous release (e.g., modified or added methods)
T7	Additional different method coverage	Test cases are prioritized using both feedback and modification information
T8	Total risk coverage	According to total risk indices of the covered classes, the test cases are prioritized

Table S3 Parameter settings

Software	Parameter	NSGA-II	PAES	SPEA2	Traditional GA
Jmeter	Population size	300	300	300	300
	Mutation rate	0.02	1	0.02	0.15
	Crossover size	0.95	-	0.95	0.5
	Archive size	-	200	250	-
	Fitness evaluation	100,000	100,000	60,000	60,000
Xml -security, Joda -time	Population size	300	300	300	300
	Mutation rate	0.02	1	0.02	0.15
	Crossover size	0.95	-	0.95	0.5
	Archive size	-	250	250	-
	Fitness evaluation	200,000	200,000	60,000	60,000
DNS	Population size	300	300	300	300
	Mutation rate	0.02	1	0.02	0.15
	Crossover size	0.95	-	0.95	0.5
	Archive size	-	250	250	-
	Fitness evaluation	100,000	100,000	60,000	60,000
ANT	Population size	300	300	300	300
	Mutation rate	0.02	1	0.02	0.15
	Crossover size	0.95	-	0.95	0.5
	Archive size	-	250	250	-
	Fitness evaluation	60,000	60,000	60,000	60,000
BCEL	Population size	300	300	300	300
	Mutation rate	0.02	1	0.02	0.15
	Crossover size	0.95	-	0.95	0.5
	Archive size	-	250	250	-
	Fitness evaluation	100,000	100,000	60,000	60,000

Table S4 Test orders obtained by the proposed algorithm

Software	Test order
Jmeter	272 − 69 − 162 − 284 − 13 − 186 − 282 − 125 − 273 − 281 − 259 − 112 − 68 − 202 − 258 − 283 − 107 − 245 − 17 − 160 − 159 − 158 − 147 − 134 − 64 − 102 − 99 − 150 − 280 − 184 − 185 − 5 − 7 − 260 − 122 − 270 − 132 − 171 − 191 − 183 − 178 − 83 − 188 − 143 − 279 − 110 − 275 − 196 − 200 − 70 − 114 − 148 − 131 − 207 − 124 − 195 − 177 − 285 − 25 − 26 − 28 − 220 − 218 − 27 − 32 − 31 − 278 − 251 − 264 − 252 − 246 − 203 − 219 − 16 − 179 − 248 − 249 − 2 − 216 − 60 − 257 − 198 − 276 − 52 − 201 − 197 − 217 − 42 − 15 − 194 − 75 − 176 − 213 − 236 − 45 − 3 − 4 − 226 − 242 − 241 − 187 − 113 − 269 − 212 − 116 − 117 − 106 − 67 − 237 − 234 − 109 − 73 − 206 − 58 − 255 − 133 − 161 − 76 − 130 − 261 − 265 − 63 − 135 − 40 − 8 − 20 − 119 − 181 − 123 − 182 − 24 − 180 − 118 − 80 − 71 − 223 − 222 − 6 − 149 − 55 − 225 − 224 − 57 − 111 − 227 − 14 − 23 − 173 − 174 − 33 − 34 − 35 − 36 − 221 − 39 − 21 − 22 − 175 − 38 − 172 − 140 − 127 − 126 − 204 − 9 − 10 − 12 − 11 − 228 − 231 − 229 − 230 − 232 − 103 − 43 − 47 − 41 − 205 − 277 − 233 − 247 − 120 − 121 − 115 − 240 − 155 − 54 − 62 − 59 − 193 − 274 − 30 − 66 − 238 − 254 − 19 − 84 − 18 − 29 − 37 − 89 − 211 − 156 − 51 − 101 − 215 − 214 − 56 − 53 − 61 − 65 − 239 − 167 − 157 − 168 − 146 − 235 − 144 − 152 − 74 − 96 − 92 − 88 − 104 − 139 − 79 − 169 − 154 − 145 − 141 − 165 − 166 − 105 − 163 − 164 − 153 − 138 − 129 − 128 − 46 − 108 − 72 − 100 − 97 − 93 − 77 − 95 − 81 − 91 − 78 − 86 − 87 − 170 − 137 − 142 − 151 − 85 − 243 − 210 − 50 − 136 − 192 − 190 − 271 − 250 − 268 − 266 − 256 − 82 − 253 − 244 − 267 − 189 − 263 − 262 − 208 − 90 − 44 − 49 − 48 − 1 − 94 − 98 − 199 − 209
Xml-security	206 − 6 − 200 − 66 − 192 − 36 − 167 − 171 − 87 − 213 − 198 − 195 − 207 − 2 − 86 − 188 − 197 − 161 − 150 − 151 − 10 − 9 − 214 − 199 − 11 − 98 − 156 − 189 − 212 − 203 − 85 − 82 − 33 − 65 − 187 − 64 − 5 − 67 − 174 − 193 − 153 − 53 − 194 − 81 − 170 − 168 − 185 − 211 − 205 − 13 − 196 − 71 − 89 − 202 − 12 − 35 − 34 − 210 − 201 − 172 − 3 − 31 − 4 − 30 − 61 − 191 − 52 − 51 − 84 − 77 − 78 − 75 − 103 − 102 − 8 − 26 − 14 − 25 − 80 − 72 − 19 − 154 − 158 − 157 − 21 − 148 − 74 − 76 − 42 − 107 − 58 − 57 − 90 − 94 − 88 − 92 − 91 − 190 − 41 − 39 − 49 − 43 − 44 − 45 − 47 − 162 − 152 − 155 − 159 − 182 − 177 − 219 − 216 − 176 − 217 − 131 − 183 − 181 − 218 − 93 − 180 − 114 − 186 − 46 − 178 − 142 − 48 − 179 − 139 − 140 − 146 − 116 − 73 − 54 − 59 − 60 − 173 − 27 − 28 − 20 − 7 − 29 − 18 − 100 − 37 − 175 − 184 − 62 − 204 − 215 − 101 − 40 − 108 − 109 − 110 − 111 − 106 − 97 − 96 − 95 − 22 − 23 − 24 − 15 − 16 − 17 − 38 − 32 − 209 − 208 − 1 − 149 − 166 − 68 − 55 − 160 − 164 − 165 − 127 − 145 − 135 − 143 − 125 − 163 − 137 − 134 − 121 − 144 − 147 − 129 − 117 − 130 − 124 − 120 − 119 − 112 − 115 − 126 − 69 − 128 − 132 − 118 − 122 − 136 − 133 − 138 − 113 − 141 − 50 − 56 − 104 − 105 − 99 − 123 − 79 − 63 − 70 − 83 − 169
Joda-time	144 − 5 − 31 − 1 − 10 − 11 − 137 − 30 − 6 − 12 − 111 − 105 − 118 − 107 − 114 − 120 − 33 − 23 − 94 − 108 − 124 − 90 − 152 − 125 − 138 − 109 − 26 − 3 − 135 − 121 − 122 − 4 − 16 − 24 − 25 − 27 − 28 − 29 − 32 − 104 − 62 − 55 − 117 − 116 − 54 − 112 − 106 − 115 − 110 − 126 − 119 − 36 − 42 − 86 − 87 − 89 − 91 − 95 − 102 − 130 − 132 − 139 − 133 − 134 − 140 − 141 − 145 − 146 − 143 − 142 − 46 − 151 − 8 − 56 − 7 − 131 − 128 − 129 − 81 − 83 − 63 − 136 − 58 − 59 − 64 − 73 − 65 − 113 − 80 − 150 − 71 − 75 − 123 − 82 − 41 − 47 − 2 − 19 − 43 − 14 − 69 − 44 − 49 − 15 − 20 − 103 − 45 − 48 − 50 − 52 − 21 − 53 − 9 − 18 − 34 − 37 − 40 − 57 − 60 − 76 − 61 − 67 − 68 − 78 − 74 − 72 − 77 − 79 − 70 − 66 − 84 − 85 − 97 − 99 − 101 − 88 − 92 − 93 − 96 − 98 − 100 − 127 − 51 − 39 − 35 − 17 − 22 − 38 − 13 − 147 − 148 − 156 − 149 − 153 − 155 − 154
DNS	8 − 36 − 17 − 46 − 44 − 31 − 28 − 5 − 47 − 27 − 15 − 53 − 10 − 13 − 49 − 21 − 14 − 22 − 48 − 32 − 18 − 58 − 39 − 43 − 19 − 26 − 41 − 23 − 29 − 40 − 45 − 25 − 20 − 35 − 55 − 42 − 56 − 34 − 6 − 16 − 30 − 24 − 54 − 57 − 4 − 9 − 11 − 7 − 37 − 1 − 2 − 59 − 51 − 61 − 60 − 50 − 12 − 38 − 52 − 3 − 33
ANT	15 − 12 − 3 − 9 − 8 − 2 − 4 − 16 − 19 − 20 − 1 − 7 − 5 − 6 − 14 − 17 − 21 − 25 − 22 − 23 − 10 − 18 − 13 − 24 − 11
BCEL	20 − 42 − 41 − 8 − 17 − 15 − 13 − 10 − 6 − 19 − 11 − 12 − 14 − 16 − 7 − 9 − 18 − 33 − 2 − 21 − 34 − 43 − 44 − 25 − 5 − 1 − 22 − 45 − 4 − 39 − 37 − 36 − 30 − 31 − 27 − 35 − 32 − 40 − 28 − 26 − 3 − 38 − 29 − 23 − 24

Table S5 Comparison of experimental results for Jmeter

Strategy	N_s	OCplx	NM	NA	N_p	N_{ft}	PR	ΣBf	$APFD_r$	Time* (s)
Tai and Daniels (1999)'s	26	1.54	58	1	47/86	6/11	0.4386	0.2848	0.4936	1.02
Abdurazik and Offutt (2006)'s	17	0.46	24	0	38/86	5/11	0.4073	0.8854	0.5231	1.16
Briand et al. (2002)'s	17	1.24	49	2	37/86	6/11	0.4221	0.3404	0.4672	6.23
Briand et al. (2003)'s	16	0.98	34	1	39/86	6/11	0.4678	0.4773	0.5117	**0.92**
Le Traon et al. (2000)'s	31	2.19	75	3	42/86	7/11	0.4432	0.2024	0.4369	1.06
Jiang et al. (2011)'s	15	0.68	29	1	40/86	5/11	0.4417	0.6496	0.5488	1.01
NSGA-II in Assunção et al. (2014)	29	0.79	40	0	60/86	7/11	0.6009	0.7649	0.6329	48.97 (0.43)
PAES in Assunção et al. (2014)	**13**	**0.39**	20	0	49/86	7/11	0.3919	0.9978	0.6287	37.28 (0.97)
SPEA2 in Assunção et al. (2014)	41	1.28	60	0	55/86	8/11	0.7016	0.5954	0.6023	337.13 (104.47)
Risk-based GA	15	0.47	24	1	52/86	6/11	0.5302	1.1281	0.5595	7.98
Risk-based NSGA-II	20	0.84	41	1	**84/86**	10/11	**0.9094**	1.0826	0.7841	65.63 (1.20)
Risk-based PAES	20	0.76	38	0	83/86	11/11	0.8756	1.1522	0.7887	43.81 (1.32)
Risk-based SPEA2	20	0.84	40	2	83/86	8/11	0.8536	1.0162	0.7822	148.38 (33.14)
Ours	14	0.42	21	0	82/86	11/11	0.8568	**2.0400**	**0.9012**	1.08

N_S is the number of constructed test stubs, OCplx represents the total complexity of the test stubs, NM and NA denote the numbers of simulation methods and attributes in the stubs, respectively, N_p is the number of tested nodes ranking in the top 30% of classes by the risk index after half of the classes are tested, N_{ft} represents the number of faults detected in the middle of integration testing, PR denotes the degree of "high-risk classes being integrated first" in the test order, ΣBf is the benefit rate of the obtained test order, which equals PR/OCplx, and $APFD_r$ reflects the detection efficiency for high-risk faults. Better results are shown in bold

* The value in the brackets represents the standard deviation

Table S6 Comparison of experimental results for Xml-security

Strategy	N_s	OCplx	NM	NA	N_p	N_{ft}	PR	ΣBf	$APFD_r$	Time (s)
Tai and Daniels (1999)'s	34	2.94	84	5	32/66	3/10	0.4345	0.1478	0.4221	0.99
Abdurazik and Offutt (2006)'s	21	1.82	54	1	32/66	4/10	0.4421	0.2429	0.4276	0.96
Briand et al. (2002)'s	23	1.99	56	3	35/66	4/10	0.4575	0.2299	0.4572	27.12
Briand et al. (2003)'s	19	1.65	50	1	34/66	4/10	0.4732	0.2868	0.5196	1.03
Le Traon et al. (2000)'s	47	4.06	118	3	36/66	5/10	0.4235	0.1043	0.4554	0.98
Jiang et al. (2011)'s	18	1.56	42	6	33/66	4/10	0.4641	0.2975	0.5297	**0.89**
NSGA-II in Assunção et al. (2014)	21	1.51	43	2	44/66	5/10	0.6314	0.4169	0.6459	64.88 (1.98)
PAES in Assunção et al. (2014)	**11**	**1.29**	40	0	42/66	5/10	0.6298	0.4899	0.6522	31.37 (0.90)
SPEA2 in Assunção et al. (2014)	26	1.88	55	1	45/66	5/10	0.6372	0.338	0.6372	330.28 (215.08)
Risk-based GA	19	1.42	39	4	46/66	6/10	0.6398	0.4506	0.6647	33.76
Risk-based NSGA-II	30	1.68	48	3	**63/66**	9/10	**0.9013**	0.5355	0.7514	70.41 (2.20)
Risk-based PAES	23	1.48	43	1	62/66	9/10	0.8618	0.5819	0.7596	47.91 (1.93)
Risk-based SPEA2	26	1.78	52	1	62/66	9/10	0.8998	0.5044	0.7538	207.55 (100.76)
Ours	16	1.38	41	0	62/66	**10/10**	0.8753	**0.6342**	**0.9136**	0.92

Table S7 Comparison of experimental results for Joda-time

Strategy	N_s	OCplx	NM	NA	N_p	N_{ft}	PR	ΣBf	$APFD_r$	Time (s)
Tai and Daniels (1999)'s	79	1.64	98	16	23/47	6/15	0.4232	0.258	0.3523	16.33
Abdurazik and Offutt (2006)'s	43	0.89	54	8	24/47	6/15	0.4076	0.458	0.4837	19.22
Briand et al. (2002)'s	46	0.96	64	3	22/47	6/15	0.4155	0.4328	0.4145	32.46
Briand et al. (2003)'s	48	0.99	23	46	23/47	7/15	0.4638	0.4685	0.4263	**15.43**
Le Traon et al. (2000)'s	93	1.94	78	56	25/47	8/15	0.4474	0.2306	0.3368	18.96
Jiang et al. (2011)'s	53	1.1	48	28	24/47	5/15	0.4693	0.4266	0.4021	17.85
NSGA-II in Assunção et al. (2014)	50	0.91	67	2	27/47	9/15	0.5339	0.5891	0.6214	40.02 (0.69)
PAES in Assunção et al. (2014)	46	**0.82**	54	2	25/47	9/15	0.4878	0.5963	0.6316	14.92 (0.92)
SPEA2 in Assunção et al. (2014)	45	0.98	67	1	25/47	8/15	0.5033	0.5138	0.6016	599.31 (230.99)
Risk-based GA	43	0.86	40	23	26/47	7/15	0.5135	0.5971	0.5731	35.23
Risk-based NSGA-II	54	1.12	75	3	41/47	12/15	0.8645	0.7694	0.7790	45.90 (1.31)
Risk-based PAES	46	1.02	70	1	40/47	12/15	0.8405	0.8217	0.7822	18.86 (0.75)
Risk-based SPEA2	54	1.31	90	1	40/47	10/15	0.8577	0.6542	0.7522	220.52 (79.15)
Ours	**41**	0.85	59	0	**43/47**	**15/15**	**0.8953**	**1.0533**	**0.9088**	17.24

Table S8 Comparison of experiment results for DNS

Strategy	N_s	OCplx	NM	NA	N_p	PR	ΣBf	Time (s)
Tai and Daniels (1999)'s	27	2.06	32	61	7/18	0.4562	0.2215	0.53
Abdurazik and Offutt (2006)'s	8	1.33	13	14	7/18	0.4327	0.3253	0.67
Briand et al. (2002)'s	**6**	1.47	11	19	7/18	0.4346	0.2956	4.68
Briand et al. (2003)'s	**6**	1.51	11	23	7/18	0.4663	0.3088	0.54
Le Traon et al. (2000)'s	10	4.41	77	75	8/18	0.4822	0.1093	0.78
Jiang et al. (2011)'s	**6**	1.59	11	22	7/18	0.416	0.2616	0.82
NSGA-II in Assunção et al. (2014)	**6**	**1.27**	7	17	8/18	0.7347	0.5785	6.34 (0.89)
PAES in Assunção et al. (2014)	14	1.62	14	22	8/18	0.7458	0.4604	3.78 (0.10)
SPEA2 in Assunção et al. (2014)	16	1.70	21	12	7/18	0.7313	0.4302	223.89 (126.65)
Risk-based GA	8	1.51	13	19	10/18	0.6106	0.4044	5.11
Risk-based NSGA-II	16	1.79	28	14	**16/18**	**0.8989**	0.5022	7.37 (0.14)
Risk-based PAES	16	1.63	20	15	**16/18**	0.8013	0.4916	4.52 (0.25)
Risk-based SPEA2	16	1.76	30	12	14/18	0.8247	0.4686	176.93 (72.83)
Ours	**6**	**1.27**	7	17	15/18	0.8157	**0.6423**	**0.49**

Table S9 Comparison of experimental results for ANT

Strategy	N_s	OCplx	NM	NA	N_p	PR	ΣBf	Time (s)
Tai and Daniels (1999)'s	28	7.41	89	463	3/8	0.4527	0.0611	0.62
Abdurazik and Offutt (2006)'s	14	3.37	89	47	4/8	0.4328	0.1284	0.55
Briand et al. (2002)'s	13	3.44	92	49	4/8	0.4475	0.1301	4.85
Briand et al. (2003)'s	11	3.68	25	163	3/8	0.4337	0.1179	**0.51**
Le Traon et al. (2000)'s	19	5.70	78	307	3/8	0.4982	0.0874	0.63
Jiang et al. (2011)'s	**10**	3.28	26	146	4/8	0.4329	0.1320	0.67
NSGA-II in Assunção et al. (2014)	13	**2.89**	36	83	4/8	0.7213	0.2496	2.45 (0.06)
PAES in Assunção et al. (2014)	13	**2.89**	36	83	4/8	0.7353	0.2544	0.60 (0.01)
SPEA2 in Assunção et al. (2014)	13	**2.89**	36	83	4/8	0.7305	0.2527	161.48 (59.75)
Risk-based GA	16	3.49	31	121	6/8	0.7162	0.2052	5.46
Risk-based NSGA-II	15	3.07	43	84	**7/8**	**0.9469**	**0.3084**	3.03 (0.10)
Risk-based PAES	15	3.57	68	90	**7/8**	0.9420	0.2639	0.67 (0.02)
Risk-based SPEA2	15	3.61	49	116	**7/8**	0.9419	0.2609	76.49 (34.15)
Ours	14	3.04	44	79	**7/8**	0.9198	0.3026	0.53

Table S10 Comparison of experimental results for BCEL

Strategy	N_s	OCplx	NM	NA	N_p	PR	ΣBf	Time (s)
Tai and Daniels (1999)'s	128	15.96	182	219	4/14	0.4572	0.0286	15.09
Abdurazik and Offutt (2006)'s	77	8.86	87	89	5/14	0.4127	0.0466	15.28
Briand et al. (2002)'s	73	8.44	96	64	5/14	0.4873	0.0577	15.23
Briand et al. (2003)'s	70	9.67	72	117	5/14	0.4368	0.0452	14.85
Le Traon et al. (2000)'s	**67**	16.78	326	92	6/14	0.4552	0.0271	14.97
Jiang et al. (2011)'s	73	13.75	139	157	5/14	0.4219	0.0307	14.92
NSGA-II in Assunção et al. (2014)	78	**8.36**	112	49	7/14	0.6678	0.0799	5.93 (0.27)
PAES in Assunção et al. (2014)	79	8.53	52	103	7/14	0.6625	0.0777	**2.24 (0.06)**
SPEA2 in Assunção et al. (2014)	83	8.62	78	84	7/14	0.6543	0.0759	176.29 (71.64)
Risk-based GA	80	9.45	136	45	7/14	0.7121	0.0754	17.05
Risk-based NSGA-II	84	9.18	85	101	11/14	**0.8122**	0.0885	6.38 (0.17)
Risk-based PAES	81	9.07	99	82	10/14	0.7320	0.0807	2.67 (0.07)
Risk-based SPEA2	81	9.27	118	68	10/14	0.7996	0.0863	95.11 (32.79)
Ours	75	8.90	77	99	**12/14**	0.7908	**0.0889**	14.98