| | MD5 | # behaviors | ors | | rate of new def-uses | zf-uses | | new behaviors | 9 | MD5 | API | API count | | new def-use rate | ate | new behavior | navior r | ate |
|----------|--|-------------------|----------|----------|----------------------|---------|-------|---------------|---------------|--|--------|-----------|---------------|------------------|--------|------------------|----------|------|
| - | TOW CONTRACTOR CONTRACTOR AND | DueForce PMP BDA* | P BD | A* Duer | orce | * . | | | į | \rightarrow | eForce | PMP B1 | y | | BDA* | DueForce PMP BDA | PMP | 3DA* |
| - | - | | + | П | | N/A | 0.000 | \dashv | \rightarrow | - | | + | \neg | 0.615 | | 0.300 | 0.153 | N/A |
| 7 | | | \dashv | \neg | | A/A | 0.304 | | \rightarrow | \rightarrow | | _ | \neg | 0.465 | \neg | 0.264 | 0.159 | A/A |
| n | - | | | | 0.708 | N/A | 0.400 | | 53 | | | _ | | 0.423 | | 0.458 | 0.119 | N/A |
| 4 | 030414ebdf3de8eed981822d8e6a3ead | 93 | N/A | | | N/A | 0.333 | | 54 | - | | - | | 0.233 | | 0.333 | 0.233 | N/A |
| S | - | 91 | N/A | \neg | | N/A | 0.333 | | \neg | | 3 | 146 N | | 0.198 | | 0.301 | 0.128 | N/A |
| 9 1 | 0aa2c68bea82206ace90a67f370b1a1d | | N/A | | | N/A | 0.333 | \rightarrow | \rightarrow | - | | \dashv | - | 0.250 | | 0.333 | 0.250 | N/A |
| - 0 | 0.2461cba/318/e1f849608082e8b13b2 2.25 | 76 | Y X | A 0.7/8 | 0.767 | N/A | 0.212 | 0.121 N/A | n or | 05/02/0a2e5b4122e4c9606025/941eb2 168 | | CCI 011 | N/A 1.000 | 000.1 | N/A | 0.315 | 0.272 | N/A |
| 0 0 | 11.08440523h455497f14b868747f3 | 11 11 | V/N | | | W/W | 0.411 | | 90 | - | | + | | 0.052 | | 0.444 | 0.130 | V/N |
| ۶ م | 11a98d4U323b41b3d8/114bb868/d/03 | 1 | + | | | N/A | 0.400 | _ | 8 | \rightarrow | | + | \neg | 0.300 | \neg | 200 | 0000 | Y Y |
| 2 | 163/96698198252/d/3ed3e40c3c38cc | | + | | | N/A | 0.392 | | 3 2 | \dashv | | | | 0.001 | | 0.504 | 0.230 | N/A |
| <u> </u> | 11 / /auct 1028e2 / 1c95 / b912084 3cdbd | 00 | N/A | \neg | | N/A | 0.300 | _ | 10 | + | | + | | 0.001 | \neg | 0.600 | 0.500 | N/A |
| 12 | 100c468b41b6a836b9bbaet520c3e624 | | \dashv | \neg | | N/A | 0.300 | \perp | 62 | \rightarrow | | \dashv | \neg | 0.511 | \neg | 0.266 | 0.111 | N/A |
| 13 | 065cab8521905a81146e35474108639b | | | | | N/A | 0.204 | | 63 | _ | | S | | 0.521 | | 0.600 | 0.260 | N/A |
| 4 | 14ee337531936a396d31a02a36f567f5 | 62 | N/A | | | N/A | 0.333 | | 2 | | | \dashv | | 0.727 | | 0.220 | 0.121 | N/A |
| 15 | 125b5621edc3ae1f51aa71bab21dbbfa | 99 | N/A | | | N/A | 0.300 | 0.153 N/A | 65 | 138701b3cf56d26d81499b7310aee269 161 | 1 | 106 N | | 0.333 | | 0.244 | 0.166 | N/A |
| 16 | 100dc0c9352ca546d5fed19f0ac86c49 | 99 | N/A | | | N/A | 0.300 | 0.153 N/A | 99 | | | | | 0.153 | | 0.300 | 0.153 | N/A |
| 17 | 00ccb3f3640b057edbfa413a11eea1d2 | | | | | N/A | 0.333 | | - 69 | 057c704695f21b4310823066680b65a5 99 | | | | 0.352 | | | 0.294 | N/A |
| 18 | | | | | | N/A | 0.289 | | 89 | - | | 107 N | | 0.166 | | 0.373 | 0.333 | N/A |
| 19 | 17407b7e2439143474c04e7fcb01d955 | 99 | | | | N/A | 0.600 | | 69 | | | | | 0.333 | | 0.400 | 0.333 | N/A |
| 50 | 1 1c4c93f58c8d3fb7d1fd0a9ef91d25ec 212 | 92 | N/A | 'A 0.602 | 0.585 | N/A | 0.277 | 0.121 N/A | 70 | 037527e60060d2d749f384092315ef60 312 | | 108 N | N/A 0.840 | 0.367 | N/A | 0.310 | 0.040 | N/A |
| 21 | 1 1737c7df90b03de848a46e04b2312540 68 | 62 | N/A | VA 0.600 | 0.250 | N/A | 0.300 | 0.250 N/A | 71 | 21d3fcbfae0c11918723d6b7795ed82e 95 | | 84 N | N/A 0.722 | 0.578 | N/A | 0.388 | 0.210 | N/A |
| 22 | 2 12f6303a698736e4ff1c0a78756aeffc 223 | | N/A | 'A 0.793 | 0.450 | N/A | 0.304 | 0.150 N/A | 72 | 126a0a35e3c28061cdb840d71671928e 68 | | N 99 | N/A 0.500 | 0.230 | N/A | 0.300 | 0.153 | N/A |
| 23 | 3 0d033ab96941b83653ee506f91abae3e 229 | 98 | N/A | 'A 0.937 | 0.769 | N/A | 0.687 | 0.153 N/A | 73 | 07ad5953f5e75f9193d9d2f93f5bf82c 150 | | 146 N | N/A 0.946 | 0.871 | N/A | 0.157 | 0.110 | N/A |
| 24 | 1 0545a5fa772589b157c33c7f9aa7cd58 148 | | - | | | N/A | 0.180 | 0.132 N/A | 74 | 130cffb3f0e3a5664c6db693c28ba423 223 | | | N/A 0.583 | 0.250 | N/A | 0.291 | 0.250 | N/A |
| 25 | 5 10f0eb3de05aa33759a299659ace1adf 68 | 99 | N/A | 'A 0.500 | 0.307 | N/A | 0.300 | 0.153 N/A | 75 | 0e9f683d7f41ca3ee2a488b99992aadc 93 | | N 68 | N/A 0.857 | 0.730 | N/A | 0.500 | 9200 | N/A |
| 56 | 09bea0cb3cd21df17ea12f801bcdd482 | 99 | N/A | | | N/A | 0.300 | 0.153 N/A | 9/ | 00215a40448c9c38de3a0f9b0b332b36 99 | | N 69 | N/A 0.541 | 0.500 | | 0.333 | 0.250 | N/A |
| 27 | 04f22d84481d45065c85a9b6a39828b3 | 99 | N/A | | 0.300 | N/A | 0.500 | 0.200 N/A | 77 | 133793a644971095a06c813af586aeec 179 | | _ | N/A 0.983 | 0.750 | | 0.258 | 0.125 | N/A |
| 78 | 0a306fe255b84d87094e0e1a3f55e8d6 | 16 | Н | | | N/A | 0.333 | | 78 | 086fbf73fbd9dbe5eb34458e7a43dbc6 188 | | | | 0.427 | | 0.853 | 0.827 | N/A |
| 29 | 11cb6952cf46d2226e9a3cb05fadc442 | | _ | | | N/A | 0.241 | | 16 | | | _ | | 0.197 | | 0.400 | 0.131 | N/A |
| 30 | 1aace15b3a004ef9952d5769af7f39ac | | | | | N/A | 0.545 | | 80 | | 9 | | | 0.221 | | 0.311 | 0.147 | N/A |
| 31 | 11508a3daf1e0a3cd618be1956285cec | 99 | N/A | | | N/A | 0.300 | | | - | | | | 0.307 | | 0.300 | 0.153 | N/A |
| 32 | 1c3d99fe5fc815ecf51fd63831e967bc | | \dashv | \neg | | N/A | 0.375 | ~ | \neg | | | ~ | \neg | 0.181 | | 0.444 | 0.181 | N/A |
| 33 | 1323fc9b60179cea3cc01dfa80ac9281 | | | | | N/A | 0.303 | | 83 | | | | | 0.666 | | 0.184 | 0.121 | N/A |
| 8 | 0d5eb8ee9e5212bc4fd697c342f7bd43 | 95 | N Y | \neg | | N/A | 0.333 | | 2 | \neg | | \dashv | \neg | 0.230 | | 0.300 | 0.153 | N'A |
| S | 05642ebaad493905/0925/256441191e | 9 | Y X | \neg | | A/A | 0.300 | | 8 | \rightarrow | | 90 6 | \neg | 0.384 | \neg | 0.300 | 0.153 | A/A |
| 30 | 1/azbd3/205atd412dd113/0/9d8dab/ | | + | | | N/A | 0.555 | - 1 | 80 | \neg | | | \neg | 0.142 | | 0.555 | 0.142 | N/A |
| ς « | 7 | 117 | Y Z | A 0.363 | 0.303 | A/N | 0.430 | 0.142 N/A | ò | 03961 / 40ecct 922 / 1124c83 b8d46b1332 99 | | t 0 | N/A 0.341 | 0.400 | A/A | 0.300 | 0.200 | K/N |
| 39 | 230f55d41a5cddee4a556b2773e0ba80 | | + | | | N/A | 0.257 | | 68 | _ | | | | 0.282 | | 0.264 | 0.205 | N/A |
| 40 | | 92 | ╀ | Т | | N/A | 0.162 | 0.121 N/A | 96 | 2290ade095eef194f19267d57d7b299f 68 | | ╁ | N/A 0.400 | 0.153 | N/A | 0.300 | 0.153 | N/A |
| 4 | - | 137 | N/A | A 0.406 | | N/A | 0.308 | 0.150 N/A | 91 | 011a56073209aa867e4caa20f115a0f1 99 | | | N/A 0.416 | 0.391 | N/A | 0.333 | 0.260 | N/A |
| 42 | 2 1ff1a002e845ef9835d2fb89a333976b 212 | 107 | | 'A 0.615 | 0.187 | N/A | 0.274 | 0.125 N/A | 92 | 0e6a9873ad5493d2bffbd66e63054543 68 | | N 99 | N/A 0.500 | 0.230 | N/A | 0.300 | 0.153 | N/A |
| 43 | 3 11e069cb3517abc08d50a3a096c23c94 198 | 178 | H | 'A 0.950 | 0.427 | N/A | 928.0 | 0.873 N/A | 93 | 15e3e144691e07e61ce2a41b2667f5e2 223 | | 147 N | N/A 0.858 | 0.391 | N/A | 0.304 | 0.141 | N/A |
| 4 | 0f83115e13d9caac66e2d42b4b716b7a | | \vdash | | | N/A | 0.293 | | 94 | | 4 | | | 0.363 | | 0.315 | 0.181 | N/A |
| 45 | 145081d4b18a725dcb82f79f8f74f331 | | \dashv | \neg | | N/A | 0.520 | | \rightarrow | | | \dashv | | 0.750 | | 0.333 | 0.312 | N/A |
| 46 | 0b79c855e4cde9f205e8c1a04ad44b94 | | N/A | | | N/A | 0.437 | | | _ | | 1 | | 0.230 | | 0.300 | 0.153 | N/A |
| 47 | 0418fb7e204224db6af375a5f0091da4 | | + | | | A/A | 0.300 | | 26 | - | 1 | + | \neg | 0.582 | | 0.407 | 0.087 | AN S |
| \$ \$ | 00900400a15100ea5c0e590c530d0a48 | | N/A | | | N/A | 0.322 | 0.070 N/A | 8 8 | 1/6a/II/0ddc/8380/490a41b3c8e4308 223 | c | 1 | N/A 0.815 | 0.111 | | 0.293 | 77770 | N/A |
| 4 6 | 9 0colo1/900e4a34888330b188883393d 08 | 00 | N/A | A 0.700 | 0.338 | N/A | 0.300 | | 8 5 | _ | | 60 | $\neg \vdash$ | 0.730 | N/A | 0.333 | 0.230 | N/A |
| 3 | 00/bd61a496402029/103fe619b6dffa | 5 | - | \neg | | N/A | 0.333 | 0.23U N/A | 100 | 10c13032d3ebeoa3012abd1/19944era 08 | | - | VA 0.900 | 0.015 | \neg | 005.0 | 0.133 | N/A |

| | | | | - | | | | | | i | | - | | |
|-----|--|--------------|------|-------|----------------------|----------|---------------|---------------|---|--------------|----------|-----------------------|-------------------|---------------|
| А | MD5 | # behaviors | | P | rate of new der-uses | rate of | w ben | А | MD5 | API count | | 4 | new behavior rate | |
| | \rightarrow | Duerorce PMP | BDA* | | RD/ | DueForce | PMP | + | \dashv | DueForce PMP | BDA* | BDA* | DueForce PMP | |
| 101 | - | 25 | 7 | 0.789 | 0.0 | | \rightarrow | _ | \neg | 185 | | 0.049 | 0.368 | 0.298 |
| 102 | _ | 35 | 16 | 0.857 | 0.37 | - | | \rightarrow | \rightarrow | 26 | | 0.181 | 0.140 | _ |
| 501 | - | 10 | C7 - | 0.007 | 0.754 | | - | _ | 408/3/0e1/21/01248eb210003420/90_30 | 30 | 25 0.037 | 0.203 | 0.000 | _ |
| 101 | | 30 | | 0.729 | | 0.200 | | _ | _ | 5 2 | | 0.277 | 0.230 | - |
| COI | 350d923ct1/92151e6540ca38b3d6d19 | 34 | 6 | 0.800 | <u>~</u> | | \rightarrow | _ | \neg | 31 | | 0.030 | 0.000 | 0.007 |
| 106 | d08/4ba34ctbdf/14tct2c0a11/cc8e2 | 89 - | 23 | 0.519 | 0.136 | | 0.037 0.036 | | | 38 | 26 0.739 | 0.192 | 0.229 | _ |
| 10 | 1 | 14 | 77 | 0.333 | 0.119 | 0.428 | - | 4 | \neg | 0 2 | T | 0.187 | 0.809 | - |
| 108 | _ | 28 | 18 | | 25 | | _ | _ | ., | 4/ | | 0.186 | 0.112 | _ |
| 109 | \dashv | 30 | 2 | | 2 | | _ | \rightarrow | \neg | 88 | | 0.215 | 0.026 | - |
| 110 | 17579313f14995e2bfa75a703562debf 73 | 82 | 57 | | 0.490 0.222 | 0.667 | 0.152 0.124 | 160 f2b0 | f2b00b27e6e8d10d3c27525ecd9af120 38 | 37 | 15 0.889 | 0.500 0.250 0.667 | 0.250 | 0.250 |
| 111 | 705df7bc13a3fc1bbfc79735455fda68 50 | 47 | 23 | 0.667 | 0.142 | 0.750 | | 161 5b36 | 5b36aebed504b73123e10de21529b638 51 | 48 | | 0.200 | 0.121 | 0.111 |
| 112 | 09e4b26df6b499a81453766c17226106 36 | 35 | 13 | 0.833 | 0.545 0.272 | 0.250 | 0.090 0.090 | 162 0451 | 045136430edac124ea134bf2a32a4a60 48 | 39 | 12 0.708 | 0.555 0.300 0.167 | 0.133 | 0.125 |
| 113 | 0c1aa91e8cae4352eb16d93f17c0da2b 48 | 39 | 1 | 0.679 | 0.531 0.270 | | 0.127 0.108 | 163 2ad2 | 2ad28d994083eb88d56eded361d7e381 35 | 35 | 4 0.833 | 0.545 0.272 0.500 | 0.090 | 0.090 |
| 114 | 113c079464639b4a12826b42c1d96ac7 62 | 89 | 55 | 0.727 | 0.211 | 0.429 | 0.115 0.105 | 164 005 | 005449f26bb0033c8ba5cfbb5c2c6f6b 48 | 20 | 14 0.718 | 0.020 0.017 0.100 | 0.001 | 0.008 |
| 115 | | 36 | 18 | 0.668 | 0.270 | | _ | - | 75e04ad828359d2d25718430bc5f3dd3 39 | 78 | | 0.266 | 0.097 | 0.088 |
| 116 | 96804156396bce25d49c4ea4f058d569 | 37 | 24 | 0.818 | 0.312 | 0.545 | - | + | 8f194847387186899cc8d9f9ca903e07 39 | 39 | T | 0.166 | 0.071 | 0.083 |
| 117 | +- | 42 | 33 | 0.781 | 0.196 | | | _ | 11c489ddea858030b23f7ac184994439 31 | 31 | | 0.222 | 0.222 | 0.222 |
| 118 | a4eecf76f4c90fb8065800d4cad391df 136 | 40 | 22 | 0.500 | | | 0.428 0.428 | 168 5e89 | 5e890cb3f6cba8168d078fdede090996 38 | 43 | 30 0.889 | 0.652 0.333 0.667 | 0.304 | 0.277 |
| 119 | 10 | 103 | S | 0.720 | 0.140 0.057 | 0.036 | | _ | _ | 70 | | 0.008 | 0.001 | 0.008 |
| 120 | 14 | 30 | 19 | 0.731 | 0.002 | 0.129 | | + | ad76e4b7470df9368380b2b5375410b4 91 | 89 | 18 0.495 | 0.175 | 0.028 | - |
| 121 | | 102 | 2.1 | 0.159 | 0.065 | | - | + | - | 43 | | 0.277 | 0.277 | - |
| 122 | \top | 39 | 28 | 0.677 | 0.206 | | _ | 172 d3a8 | d3a894f6052ecee1ca87b69e619ca0ch 37 | 30 | | 3 0.214 | 0.250 | _ |
| 123 | | 42 | 23 | 0.778 | 0.250 | 0.667 | | 173 57h4 | 57h4d2108051dhe43d7h35777ha76d40 38 | 3 2 | T | 0000 | 000 | - |
| 127 | | 30 | 3 5 | 0.500 | 0.250 | 0000 | _ | - | | 30 | 227.0 71 | 0.317 | 0.142 | _ |
| 125 | ١, | 35 | 17 | 0.500 | 0.230 | 0.500 | | | 717ula040653ulaC0060011a274a47536 52 7e503ef1eb75873681e67ea4f40e31e3 54 | 37 | 0170 71 | 0.050 | 0.081 | - |
| 125 | 90833-6 - 6-2142 - 6075282501-0025-0- | 5 | 3 5 | 0.000 | 0.220 | | | + | $^{+}$ | 6 | | 0.230 | 0.001 | - |
| 971 | 898ddebarb3142eb0/328339b0933e9e | 31 | 71 6 | 0.000 | 0.222 | 0.000 | _ | 1/6 dae | dae91d1c16b6ree/13133182c62d4e10 84 | Q 6 | | 0.189 | 0.209 | _ |
| /71 | \neg | 30 | 17 | 0.733 | 0.002 | 0.090 | \rightarrow | \rightarrow | \rightarrow | 39 | T | 0.222 | 0.285 | _ |
| 128 | | 31 | 12 | 0.697 | 5 5 | 0.104 | \rightarrow | - | - | 20 | | 0.006 | 0.007 | 0.000 |
| 129 | \rightarrow | 45 | 27 | | 0.213 | 0.278 | _ | \rightarrow | be0db913011e51e3424be7841b13fd05 47 | 39 | T | 0.003 | 0.001 | _ |
| 130 | 9d2b507212c19a9dcf95168745e793ea | 170 | 102 | | 0.188 | 0.400 | | _ | 912bca5947944fdcd09e9620d7aa8c4a 53 | 30 | | 0.020 | 0.006 | _ |
| 131 | | 37 | 9 | 0.833 | 0.250 | 0.500 | $\overline{}$ | - | - | 39 | | 0.215 | 0.127 | - |
| 132 | 0 | 73 | 33 | 0.895 | 0.217 | 0.156 | | \rightarrow | 81b6ee216e10e17104706536c21a479a 102 | 29 | 20 0.733 | 0.234 | 0.025 | \rightarrow |
| 133 | | 35 | 11 | 0.833 | 0.272 | 0.333 | | _ | | 37 | | 0.277 | 0.250 | |
| 134 | | 33 | 56 | 0.875 | 0.333 | 0.875 | _ | \dashv | <u>~</u> | 70 | | 0.013 | 0.001 | \rightarrow |
| 135 | 582f47ec975b0ba8cate5a39cccbd552 | 19 | 2 2 | | 0.157 | 0.308 | _ | _ | \neg | 36 | | 0.244 | 0.117 | _ |
| 136 | 179c7648bb607147973c2fccbcc0e530 | 84 | 38 | | 0.244 | 0.148 | _ | | - | 19 | | 0.325 | 0.148 | _ |
| 137 | 0 | 65 | 51 | 0.628 | 0.201 | | _ | \dashv | \neg | 181 | | 0.174 | 0.347 | - |
| 138 | , | 49 | 27 | 0.667 | 0.194 | | $\overline{}$ | _ | - | 35 | 14 0.857 | 0.285 | 0.062 | _ |
| 139 | d04c492a5b78516a7a36cc2e1e8bf521 140 | 128 | ∞ | 0.177 | 0.072 | | 0.032 0.032 | - | 0c0d2ed33316dc5a92a2785007dbcb50 10 | 17 | 11 0.888 | 0.421 0.205 0.222 | 0.131 | 0.117 |
| 140 | - | 26 | 33 | 0.735 | 0.180 | | | 190 dc4c | dc4db38f6d3c1e751dcf06bea072ba9c 52 | 31 | 19 0.740 | 0.002 | 0.001 | _ |
| 141 | 23c42760532270113de57b97346edff0 58 | 47 | 42 | 0.751 | 0.165 | | _ | - | | 42 | 7 0.750 | 0.233 | 0.233 | - |
| 142 | _ | 37 | 7 | 0.333 | 0.133 | | | 192 0bc2 | 0bc2cbb5be3e651355a50c07885464bf 50 | 20 | 1 0.687 | 0.013 | 0.001 | _ |
| 143 | 8df9ec7cd1de78957ea800fd63d66051 112 | 29 | 17 | 0.446 | 0.192 | 0.250 | 0.040 0.035 | 193 46ea | 46eaf3f07c2a59e0bb284a7aacb41dc4 98 | 69 | 30 0.547 | 0.388 0.196 0.058 | 0.030 | 0.030 |
| 144 | | 69 | 18 | 0.572 | | | $\overline{}$ | - | a6617c5cb59135e05799498d264564c7 145 | 153 | | 0.033 | 0.532 | - |
| 145 | | 33 | 17 | 0.730 | 2 | | | - | 942ea0c4cb729d4878eb5b8998981228 39 | 37 | | 0.291 | 0.250 | - |
| 146 | 9361a4d5b4bf3041759bd4f727920df2 63 | 89 | 19 | 0.875 | 0.500 0.204 | 0.500 | 0.126 0.126 | 196 f3e8 | f3e8a50f0c1c3a510f882d0fdb121960 57 | 99 | 28 0.766 | 0.450 0.228 0.250 | 0.140 | 0.127 |
| 147 | 10f5beac257a92665866cdc99550b7bb | 104 | 48 | |)1 | | | . 4 | | 36 | | 0.002 | 0.001 | - |
| 148 | 6139657db08c3e9d5d2399259e8eaaa0 | 43 | 12 | | 0.266 | | 0.333 0.266 | \vdash | 1b74e8a749948d2fbf2f90486ce63fcf 63 | 38 | | | 0.229 | 0.186 |
| 149 | 2e6453a7eac407dbe47b70b72082490c | 47 | 25 | | 70 | | | | 5fb565eee5336c0b30451a0a023036b8 17 | 15 | | 0.105 | 0.055 | $\overline{}$ |
| 150 | 8c5c1e62d737ffd0dc36b2c1252ddd75 107 | 96 | 56 | 0.800 | 0.416 0.214 | 0.933 | 0.833 0.750 | 200 a278 | a27896388f0f0dad493e7d786e48eaab 60 | 37 | 28 0.750 | 0.402 0.204 0.122 | 0.085 | 0.071 |
| | | | | | | | | | | | | | | |