

소프트웨어 V&V

2nd - System Testing Report & Static Analysis

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Specification Review Result

1. Pause Timer

→ 내용 수정으로 반영

2. Reset Timer

→ 내용 수정으로 반영

3. Ring Timer

→ 내용 추가로 반영

→ 대부분의 수정사항이 내용 추가, 구체화 및 수정으로 update 하였음.

Specification Review Result

9. Show Alarm

- i. (S) isEditing이 true이고, 현재 초를 tickInterval로 나눈 나머지가 0이라면 editingIdx에 해당하는 자리를 출력하지 않습니다.

→ tickInterval에 대한 설명이 누락되어 있고, 이 조건이 무엇을 의미하는지 해석하기 어렵다.

→ 수정이 되어있지 않음

→ 그러나, 아무런 명시도 없이 내용이 수정되지 않은 부분이 가끔 있었음.
위와 같은 경우 의도대로 작성한 것이 맞는지에 대한 소통이 필요함.

Category-Partition Test - 2nd

- Testable Units and Representative Values

Group	Category	Value	Description
Mode	Mode	TimeKeeping	TimeKeeping 모드
		Alarm	Alarm 모드
		Timer	Timer 모드
		Stopwatch	Stopwatch 모드
		World Time	World Time 모드
		Lottery	Lottery 모드
		functionSelector	기능 Selection 모드
Config	Config	Set Mode	Set 모드
		Default Mode	Default 모드

Category-Partition Test - 2nd

- Testable Units and Representative Values

Clock	Clock	Running (start)	시간이 흐르는 중인지
		notRunning (pause)	시간이 흐르지 않는 중인지
Buzzer	Buzzer	Running	Buzzer가 작동하는 중인지
		notRunning	Buzzer가 작동하지 않는 중인지
Action	Action	pressNone	아무 입력이 없는 상태
		pressMode	Mode 버튼
		pressAdjust	Adjust 버튼
		pressUp	+ 버튼
		pressDown	- 버튼
		pressLongMode	Mode 버튼을 길게 누름

Category-Partition Test - 2nd

- Testable Units and Representative Values

Function Count	Function Count	under 4	모드 4개 미만 (error)
		equals 4	모드 4개
		over 4	모드 4개 초과 (error)

		inRange	00~59
		over 59	59 초과 (error)
		under 01	01 미만 (error)
	Lottery	inRange	01~45
		over 45	45 초과 (error)

Value	Year	under 0000	0000 미만 (error)
		inRange	0000-9999
		over 9999	9999 초과 (error)
	Month	under 1	1 미만 (error)
		inRange	1~12
		over 12	12 초과 (error)
	Day	under 1	1 미만 (error)
		inRange	1~Lastday
		over Lastday	Lastday 초과 (error)
	NormalHour	under 00	00 미만 (error)
		inRange	00~60
		over 23	60 초과 (error)
	EvHour	under 00	00 미만 (error)
		inRange	00~60
		over 99	99 초과 (error)
Min	under 00	00 미만 (error)	
	inRange	00~Maxmin	
	over Maxmin	Maxmin 초과 (error)	
Sec	under 00	00 미만 (error)	

Category-Partition Test - 2nd

- Category-Partition Test

No	Mode	Config	Clock	Buzzer	Action	FunctionCount	EvHour	Min	Sec	Result
73	timer 1200	set	running(start)	running	pressNone	equals 4	inRange	inRange	inRange	P
74	timer 1200	set	running(start)	running	pressMode	equals 4	inRange	inRange	inRange	P
75	timer 1200	set	running(start)	running	pressAdjust	equals 4	inRange	inRange	inRange	P
76	timer 1200	set	running(start)	running	pressUP	equals 4	inRange	inRange	inRange	P
77	timer 1200	set	running(start)	running	pressDOWN	equals 4	inRange	inRange	inRange	P
78	timer 1200	set	running(start)	running	pressLongMode	equals 4	inRange	inRange	inRange	P
79	timer 1200	set	running(start)	notRunning	pressNone	equals 4	inRange	inRange	inRange	P
80	timer 1200	set	running(start)	notRunning	pressMode	equals 4	inRange	inRange	inRange	P
81	timer 1200	set	running(start)	notRunning	pressAdjust	equals 4	inRange	inRange	inRange	P
82	timer 1200	set	running(start)	notRunning	pressUP	equals 4	inRange	inRange	inRange	P
83	timer 1200	set	running(start)	notRunning	pressDOWN	equals 4	inRange	inRange	inRange	P
84	timer 1200	set	running(start)	notRunning	pressLongMode	equals 4	inRange	inRange	inRange	P
85	timer 1200	set	notRunning(pause)	running	pressNone	equals 4	inRange	inRange	inRange	P
86	timer 1200	set	notRunning(pause)	running	pressMode	equals 4	inRange	inRange	inRange	P
87	timer 1200	set	notRunning(pause)	running	pressAdjust	equals 4	inRange	inRange	inRange	P
88	timer 1200	set	notRunning(pause)	running	pressUP	equals 4	inRange	inRange	inRange	P
89	timer 1200	set	notRunning(pause)	running	pressDOWN	equals 4	inRange	inRange	inRange	P
90	timer 1200	set	notRunning(pause)	running	pressLongMode	equals 4	inRange	inRange	inRange	P
91	timer 1200	set	notRunning(pause)	notRunning	pressNone	equals 4	inRange	inRange	inRange	P
92	timer 1200	set	notRunning(pause)	notRunning	pressMode	equals 4	inRange	inRange	inRange	P
93	timer 1200	set	notRunning(pause)	notRunning	pressAdjust	equals 4	inRange	inRange	inRange	P
94	timer 1200	set	notRunning(pause)	notRunning	pressUP	equals 4	inRange	inRange	inRange	P
95	timer 1200	set	notRunning(pause)	notRunning	pressDOWN	equals 4	inRange	inRange	inRange	P
96	timer 1200	set	notRunning(pause)	notRunning	pressLongMode	equals 4	inRange	inRange	inRange	P
97	timer 1200	default	running(start)	running	pressNone	equals 4	inRange	inRange	inRange	P
98	timer 1200	default	running(start)	running	pressMode	equals 4	inRange	inRange	inRange	P
99	timer 1200	default	running(start)	running	pressAdjust	equals 4	inRange	inRange	inRange	P
100	timer 1200	default	running(start)	running	pressUP	equals 4	inRange	inRange	inRange	P
101	timer 1200	default	running(start)	running	pressDOWN	equals 4	inRange	inRange	inRange	P
102	timer 1200	default	running(start)	running	pressLongMode	equals 4	inRange	inRange	inRange	P
103	timer 1200	default	running(start)	notRunning	pressNone	equals 4	inRange	inRange	inRange	P
104	timer 1200	default	running(start)	notRunning	pressMode	equals 4	inRange	inRange	inRange	P
105	timer 1200	default	running(start)	notRunning	pressAdjust	equals 4	inRange	inRange	inRange	P
106	timer 1200	default	running(start)	notRunning	pressUP	equals 4	inRange	inRange	inRange	P
107	timer 1200	default	running(start)	notRunning	pressDOWN	equals 4	inRange	inRange	inRange	P
108	timer 1200	default	running(start)	notRunning	pressLongMode	equals 4	inRange	inRange	inRange	P
109	timer 1200	default	notRunning(pause)	running	pressNone	equals 4	inRange	inRange	inRange	P
110	timer 1200	default	notRunning(pause)	running	pressMode	equals 4	inRange	inRange	inRange	P
111	timer 1200	default	notRunning(pause)	running	pressAdjust	equals 4	inRange	inRange	inRange	P
112	timer 1200	default	notRunning(pause)	running	pressUP	equals 4	inRange	inRange	inRange	P
113	timer 1200	default	notRunning(pause)	running	pressDOWN	equals 4	inRange	inRange	inRange	P
114	timer 1200	default	notRunning(pause)	running	pressLongMode	equals 4	inRange	inRange	inRange	P
115	timer 1200	default	notRunning(pause)	notRunning	pressNone	equals 4	inRange	inRange	inRange	P
116	timer 1200	default	notRunning(pause)	notRunning	pressMode	equals 4	inRange	inRange	inRange	P
117	timer 1200	default	notRunning(pause)	notRunning	pressAdjust	equals 4	inRange	inRange	inRange	P
118	timer 1200	default	notRunning(pause)	notRunning	pressUP	equals 4	inRange	inRange	inRange	P
119	timer 1200	default	notRunning(pause)	notRunning	pressDOWN	equals 4	inRange	inRange	inRange	P
120	timer 1200	default	notRunning(pause)	notRunning	pressLongMode	equals 4	inRange	inRange	inRange	P

No	Mode	Config	Clock	Buzzer	Action	FunctionCount	Min	Sec	Result
157	world time 1400	default	running(start)	running	pressNone	equals 4	inRange	inRange	P
158	world time 1400	default	running(start)	running	pressMode	equals 4	inRange	inRange	P
159	world time 1400	default	running(start)	running	pressAdjust	equals 4	inRange	inRange	P
160	world time 1400	default	running(start)	running	pressUP	equals 4	inRange	inRange	P
161	world time 1400	default	running(start)	running	pressDOWN	equals 4	inRange	inRange	P
162	world time 1400	default	running(start)	running	pressLongMode	equals 4	inRange	inRange	P
163	world time 1400	default	running(start)	notRunning	pressNone	equals 4	inRange	inRange	P
164	world time 1400	default	running(start)	notRunning	pressMode	equals 4	inRange	inRange	P
165	world time 1400	default	running(start)	notRunning	pressAdjust	equals 4	inRange	inRange	P
166	world time 1400	default	running(start)	notRunning	pressUP	equals 4	inRange	inRange	P
167	world time 1400	default	running(start)	notRunning	pressDOWN	equals 4	inRange	inRange	P
168	world time 1400	default	running(start)	notRunning	pressLongMode	equals 4	inRange	inRange	P

No	Mode	Config	Clock	Buzzer	Action	FunctionCount	Lottery	Result
169	Lottery 1500	set	running(start)	running	pressNone	equals 4	inRange	P
170	Lottery 1500	set	running(start)	running	pressMode	equals 4	inRange	P
171	Lottery 1500	set	running(start)	running	pressAdjust	equals 4	inRange	P
172	Lottery 1500	set	running(start)	running	pressUP	equals 4	inRange	P
173	Lottery 1500	set	running(start)	running	pressDOWN	equals 4	inRange	P
174	Lottery 1500	set	running(start)	running	pressLongMode	equals 4	inRange	P
175	Lottery 1500	set	running(start)	notRunning	pressNone	equals 4	inRange	P
176	Lottery 1500	set	running(start)	notRunning	pressMode	equals 4	inRange	P
177	Lottery 1500	set	running(start)	notRunning	pressAdjust	equals 4	inRange	P
178	Lottery 1500	set	running(start)	notRunning	pressUP	equals 4	inRange	P
179	Lottery 1500	set	running(start)	notRunning	pressDOWN	equals 4	inRange	P
180	Lottery 1500	set	running(start)	notRunning	pressLongMode	equals 4	inRange	P
181	Lottery 1500	default	running(start)	running	pressNone	equals 4	inRange	P
182	Lottery 1500	default	running(start)	running	pressMode	equals 4	inRange	P
183	Lottery 1500	default	running(start)	running	pressAdjust	equals 4	inRange	P
184	Lottery 1500	default	running(start)	running	pressUP	equals 4	inRange	P
185	Lottery 1500	default	running(start)	running	pressDOWN	equals 4	inRange	P
186	Lottery 1500	default	running(start)	running	pressLongMode	equals 4	inRange	P
187	Lottery 1500	default	running(start)	notRunning	pressNone	equals 4	inRange	P
188	Lottery 1500	default	running(start)	notRunning	pressMode	equals 4	inRange	P
189	Lottery 1500	default	running(start)	notRunning	pressAdjust	equals 4	inRange	P
190	Lottery 1500	default	running(start)	notRunning	pressUP	equals 4	inRange	P
191	Lottery 1500	default	running(start)	notRunning	pressDOWN	equals 4	inRange	P
192	Lottery 1500	default	running(start)	notRunning	pressLongMode	equals 4	inRange	P

Category-Partition Test - 2nd

- Category-Partition Test

No	Mode	Config	Clock	Buzzer	Action	FunctionCount	Result
193	functionSelector 1600	set	running(start)	running	pressNone	equals 4	P
194	functionSelector 1600	set	running(start)	running	pressMode	equals 4	P
195	functionSelector 1600	set	running(start)	running	pressAdjust	equals 4	P
196	functionSelector 1600	set	running(start)	running	pressUP	equals 4	P
197	functionSelector 1600	set	running(start)	running	pressDOWN	equals 4	P
198	functionSelector 1600	set	running(start)	running	pressLongMode	equals 4	P
199	functionSelector 1600	set	running(start)	notRunning	pressNone	equals 4	P
200	functionSelector 1600	set	running(start)	notRunning	pressMode	equals 4	P
201	functionSelector 1600	set	running(start)	notRunning	pressAdjust	equals 4	P
202	functionSelector 1600	set	running(start)	notRunning	pressUP	equals 4	P
203	functionSelector 1600	set	running(start)	notRunning	pressDOWN	equals 4	P
204	functionSelector 1600	set	running(start)	notRunning	pressLongMode	equals 4	P
205	functionSelector 1600	set	notRunning(pause)	running	pressNone	equals 4	P
206	functionSelector 1600	set	notRunning(pause)	running	pressMode	equals 4	P
207	functionSelector 1600	set	notRunning(pause)	running	pressAdjust	equals 4	P
208	functionSelector 1600	set	notRunning(pause)	running	pressUP	equals 4	P
209	functionSelector 1600	set	notRunning(pause)	running	pressDOWN	equals 4	P
210	functionSelector 1600	set	notRunning(pause)	running	pressLongMode	equals 4	P
211	functionSelector 1600	set	notRunning(pause)	notRunning	pressNone	equals 4	P
212	functionSelector 1600	set	notRunning(pause)	notRunning	pressMode	equals 4	P
213	functionSelector 1600	set	notRunning(pause)	notRunning	pressAdjust	equals 4	P
214	functionSelector 1600	set	notRunning(pause)	notRunning	pressUP	equals 4	P
215	functionSelector 1600	set	notRunning(pause)	notRunning	pressDOWN	equals 4	P
216	functionSelector 1600	set	notRunning(pause)	notRunning	pressLongMode	equals 4	P

→ 총 216개의 Test 중 216개 통과 => 100%

Pairwise Test - 2nd

- Test Case & Results

No	Mode	Config	Clock	Buzzer	Action	FunctionCount	Year	Month	Day	Hour	Min	Sec	Lottery	AlarmPage	Result
1	FunctionSelector	Set	Running	Running	pressSet	equals4	NotUse	NotUse	NotUse	NotUse	NotUse	NotUse	NotUse	NotUse	P
2	Timer	Default	NotRunning	NotRunning	pressMode	equals4	NotUse	NotUse	NotUse	valid	valid	valid	NotUse	NotUse	P
3	Timer	Set	Running	Running	pressUP	equals4	NotUse	NotUse	NotUse	valid	valid	valid	NotUse	NotUse	P
4	Stopwatch	Default	NotRunning	NotRunning	pressSet	equals4	NotUse	NotUse	NotUse	valid	valid	valid	NotUse	NotUse	P
5	TimeKeeping	Default	Running	Running	pressMode	equals4	valid	valid	valid	valid	valid	valid	NotUse	NotUse	P
6	TimeKeeping	Set	Running	NotRunning	pressDown	equals4	valid	valid	valid	valid	valid	valid	NotUse	NotUse	P
7	Lottery	Default	Running	NotRunning	pressUP	equals4	NotUse	NotUse	NotUse	NotUse	NotUse	NotUse	valid	NotUse	P
8	TimeKeeping	Default	Running	Running	pressSet	equals4	valid	valid	valid	valid	valid	valid	NotUse	NotUse	P
9	Timer	Set	NotRunning	Running	pressNone	equals4	NotUse	NotUse	NotUse	valid	valid	valid	NotUse	NotUse	P
10	Lottery	Set	Running	Running	pressDown	equals4	NotUse	NotUse	NotUse	NotUse	NotUse	NotUse	valid	NotUse	P
11	Worldtime	Set	Running	NotRunning	pressUP	equals4	NotUse	NotUse	NotUse	valid	valid	valid	NotUse	NotUse	P
12	Worldtime	Default	Running	NotRunning	pressNone	equals4	NotUse	NotUse	NotUse	valid	valid	valid	NotUse	NotUse	P
13	Lottery	Set	Running	Running	pressMode	equals4	NotUse	NotUse	NotUse	NotUse	NotUse	NotUse	valid	NotUse	P
14	Alarm	Set	NotRunning	NotRunning	pressMode	equals4	NotUse	NotUse	NotUse	valid	valid	NotUse	NotUse	valid	P
15	Stopwatch	Default	Running	Running	pressUP	equals4	NotUse	NotUse	NotUse	valid	valid	valid	NotUse	NotUse	P
16	Lottery	Default	Running	NotRunning	pressSet	equals4	NotUse	NotUse	NotUse	NotUse	NotUse	NotUse	valid	NotUse	P
17	Stopwatch	Default	NotRunning	Running	pressNone	equals4	NotUse	NotUse	NotUse	valid	valid	valid	NotUse	NotUse	P
18	Worldtime	Default	Running	Running	pressMode	equals4	NotUse	NotUse	NotUse	valid	valid	valid	NotUse	NotUse	P
19	FunctionSelector	Set	Running	NotRunning	pressUP	equals4	NotUse	NotUse	NotUse	NotUse	NotUse	NotUse	NotUse	NotUse	P
20	FunctionSelector	Set	Running	NotRunning	pressDown	equals4	NotUse	NotUse	NotUse	NotUse	NotUse	NotUse	NotUse	NotUse	P
21	Stopwatch	Default	NotRunning	Running	pressDown	equals4	NotUse	NotUse	NotUse	valid	valid	valid	NotUse	NotUse	P
22	Worldtime	Set	Running	NotRunning	pressSet	equals4	NotUse	NotUse	NotUse	valid	valid	valid	NotUse	NotUse	P
23	Alarm	Default	Running	Running	pressUP	equals4	NotUse	NotUse	NotUse	valid	valid	NotUse	NotUse	valid	P
24	TimeKeeping	Set	Running	Running	pressNone	equals4	valid	valid	valid	valid	valid	valid	NotUse	NotUse	P
25	Alarm	Default	NotRunning	Running	pressDown	equals4	NotUse	NotUse	NotUse	valid	valid	NotUse	NotUse	valid	P
26	Worldtime	Default	Running	Running	pressDown	equals4	NotUse	NotUse	NotUse	valid	valid	valid	NotUse	NotUse	P
27	Timer	Set	NotRunning	Running	pressDown	equals4	NotUse	NotUse	NotUse	valid	valid	valid	NotUse	NotUse	P
28	TimeKeeping	Set	Running	NotRunning	pressUP	equals4	valid	valid	valid	valid	valid	valid	NotUse	NotUse	P
29	FunctionSelector	Set	Running	NotRunning	pressNone	equals4	NotUse	NotUse	NotUse	NotUse	NotUse	NotUse	NotUse	NotUse	P
30	Lottery	Set	Running	Running	pressNone	equals4	NotUse	NotUse	NotUse	NotUse	NotUse	NotUse	valid	NotUse	P
31	Timer	Default	NotRunning	Running	pressSet	equals4	NotUse	NotUse	NotUse	valid	valid	valid	NotUse	NotUse	P
32	Stopwatch	Default	NotRunning	Running	pressMode	equals4	NotUse	NotUse	NotUse	valid	valid	valid	NotUse	NotUse	P
33	Alarm	Default	Running	Running	pressSet	equals4	NotUse	NotUse	NotUse	valid	valid	NotUse	NotUse	valid	P
34	Alarm	Default	Running	NotRunning	pressNone	equals4	NotUse	NotUse	NotUse	valid	valid	NotUse	NotUse	valid	P
35	Timer	Default	NotRunning	Running	pressUP	equals4	NotUse	NotUse	NotUse	valid	valid	valid	NotUse	NotUse	P
36	FunctionSelector	Set	Running	NotRunning	pressMode	equals4	NotUse	NotUse	NotUse	NotUse	NotUse	NotUse	NotUse	NotUse	P

→ 총 36개의 Test 중 36개 통과 => 100%

BruteForce Test - 2nd

● Test Case & Results

No	Use Case	Detail	Result
1-1	Set TimeKeeping	년의 최댓값 혹은 최소값에서 각각 +, - 버튼을 누를 경우, 최댓값에서 최소값으로, 최소값에서 최댓값으로 값이 변하는가?	T
1-2		십의 자리와 일의 자리가 서로 독립적인가?	T
1-3		일의 최댓값이 월 마다 다르고 윤년도 존재하는데, 프로그램에 그 부분이 적용되어 있는가?	T
2-1	Set Timer	최댓값 혹은 최소값에서 각각 +, - 버튼을 누를 경우, 최댓값에서 최소값으로, 최소값에서 최댓값으로 값이 변하는가?	T
2-2		십의 자리와 일의 자리가 서로 독립적인가?	T

3-1	Set Stopwatch	99:59:59까지 스톱워치 값이 변한 뒤 1초가 지날 경우 Pause 하는가?	T
4-1	Set Alarm	알람 2개가 동시에 울릴 때, 버튼 하나에 동시에 꺼지는가?	T
5-1	Show Alarm	알람 화면에 처음 접근 시, 제일 마지막에 설정되었던 알람이 보이는가?	T
6-1	Ring Alarm, Ring Timer	타이머와 알람이 동시에 울릴 경우, 버튼 하나에 동시에 꺼지는가?	T
7-1	Show WorldTime	마지막 혹은 첫 번째 도시에서 각각 다음/이전을 누를 경우, 마지막 도시에서 첫 번째 도시로, 첫 번째 도시에서 마지막 도시로 이동하는가?	T
8-1	Set Mode Selection	각 기능이 중복되지 않게 선택되나?	T
8-2		중복된 기능을 선택할 시, 중복된 위치에 있는 모드와 위치가 교체되는가?	T

→ 총 16개의 Test 중 16개 통과 => 100%

Static Analysis

- SonarQube Rules (CheckStyle, PMD, FindBugs)

FindBugs

No	Category
1	Bad practice
2	Correctness
3	Experimental
4	Internationalization
5	Malicious code vulnerability
6	Multithreaded correctness
7	Performance
8	Security
9	Dodgy code

PMD

No	Category
1	Best practice
2	Code Style
3	Documentation
4	Error phone
5	Multithreading
6	Performance
7	Security

CheckStyle

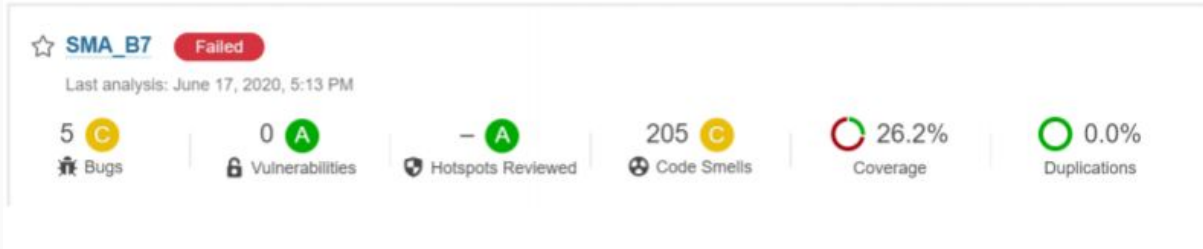
No	Category
1	Annotations
2	Block Checks
3	Class Design
4	Coding
5	Headers
6	Imports
7	Javadoc Comments
8	Metrics
9	Miscellaneous
10	Modifiers
11	Naming Conventions
12	Regexp
13	Size Violations
14	Whitespace

→ 이 3개의 정적 분석 툴의 Rule에 대하여 자체적인 검수를 통해 중요하지 않은 Rule들을 제거함.

Static Analysis

- Static Analysis Result

Overview



No	Tag	Rule	Count
1	Correctness	Class has a circular dependency with other classes	2
2	Multi-threading	Method calls wait, notify or notifyAll on a Thread instance	2
3	Multi-threading	Inconsistent synchronization	1


Bugs



(Java) Use Assert True Instead Of Asse...	19
(Java) "if ... else if" constructs should en...	12
(Java) Import Order	12
(Java) Branches should have sufficient ...	11
(Java) Lines should have sufficient cove...	10
(Java) Cyclomatic Complexity	9
(Java) Declarations should use Java coll...	9
(Java) Methods should not be too complex	9
(Java) The diamond operator ("<>") shou...	9
(Java) "Thread.sleep" should not be use...	7
(Java) Declaration Order	6
(Java) Visibility Modifier	6
(Java) Anonymous inner classes containi...	5
(Java) Boolean Get Method Name	5
(Java) The names of methods with boole...	5

Code Smell

Static Analysis

- Static Analysis Result - Code Coverage

Condition Coverage 17.9% 

	Condition Coverage	Uncovered Conditions
 src/main/java/Timer.java	0.0%	78
 src/main/java/WorldTime.java	0.0%	6
 src/main/java/Stopwatch.java	13.6%	19
 src/main/java/TimeKeeping.java	14.3%	60
 src/main/java/Alarm.java	20.7%	46
 src/main/java/TimeTicker.java	25.0%	3
 src/main/java/Lottery.java	33.3%	12
 src/main/java/ModeSelection.java	35.1%	24
 src/main/java/Mode.java	50.0%	4
 src/main/java/GlobalSettings.java	58.3%	5

10 of 10 shown

→ 전체적으로 Code Coverage가 낮는데, 이는 Test Code가 실행 코드에 비해 너무나 걸핍기 식임.