

Static Analysis 대응서

- VAT 그림판 -

Project Team

T3

Date

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Team Information

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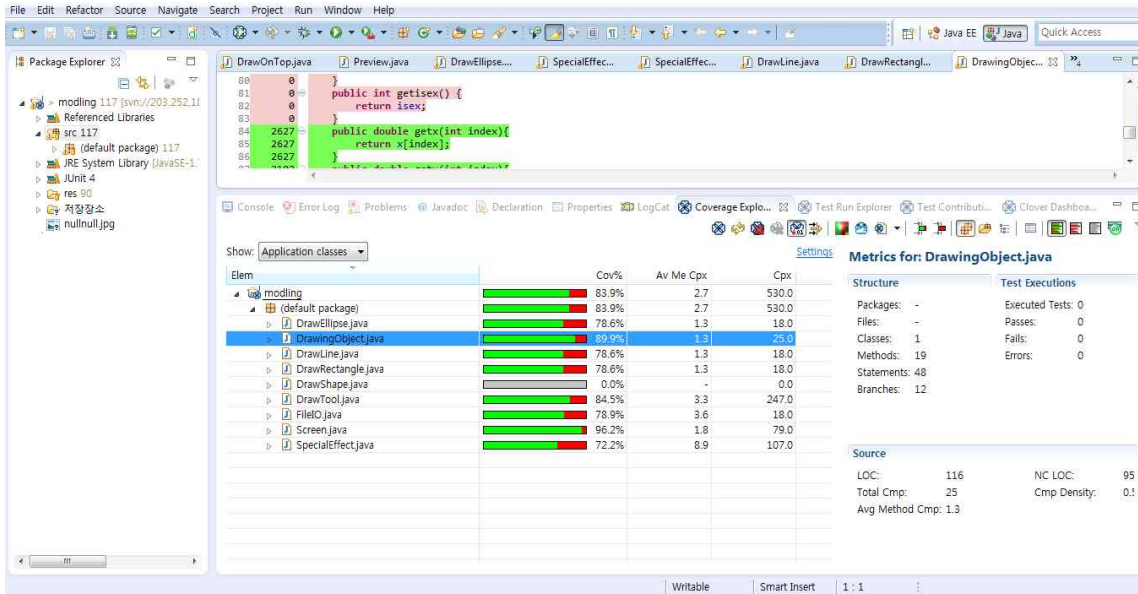
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1. Clover

1.1. Coverage Report

1.1.1. 분석 결과



총 83.9%의 coverage rate을 달성하였으며, SpecialEffect.java에서 72.2%의 가장 적은 coverage rate을 달성하였다.

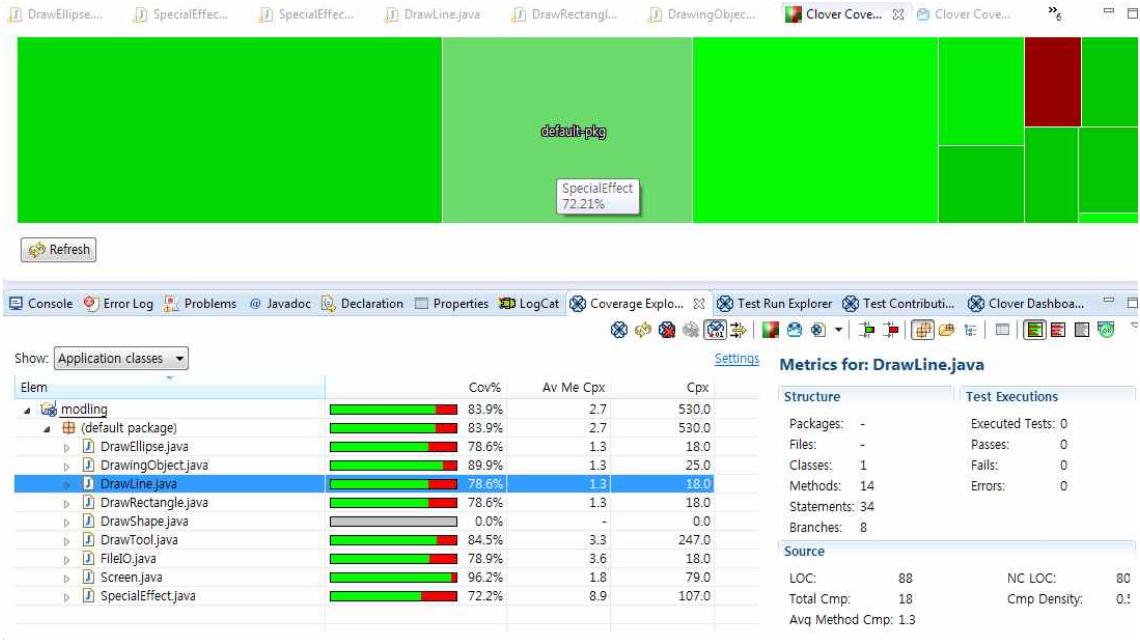
1.1.2. 대응

가장 적은 coverage rate을 달성한 SpecialEffect.java의 경우 SV팀에서 Test Case를 부족하게 입력하여 coverage rate가 작은 수치로 계산된 것을 확인할 수 있었다.

coverage rate가 전체적으로 높은 편이고, 구현한 코드를 검토해본 결과 전혀 필요 없는 코드 영역은 없는 것으로 판단되어 특별한 조치를 취하지 않았다.

1.2. Treemap Report

1.2.1. 분석 결과



사각형은 complexity를 나타내고, 사각형의 크기가 클수록 complexity가 높다.

색깔은 coverage rate를 나타내고, 의미는 다음과 같다.

- Bright green (most covered)
- Dark green (more covered)
- Black (around 50% covered)
- Dark red (little covered)
- Bright red (uncovered)

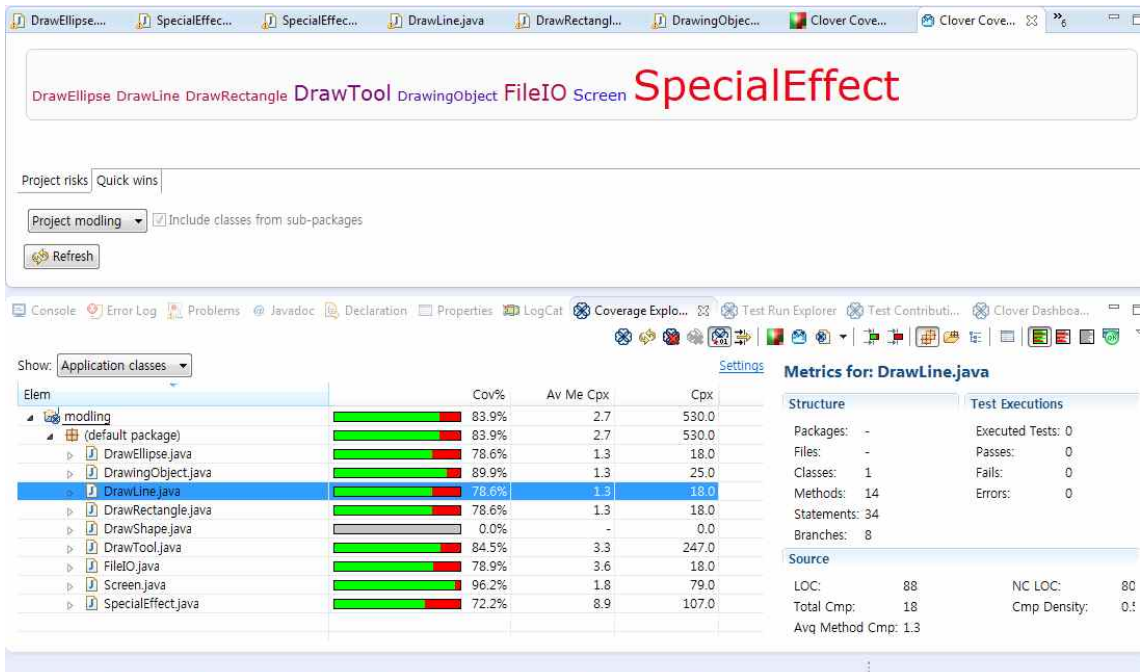
interface class를 제외하고 가장 coverage rate가 낮고 complexity가 높은 class는 SpecialEffect class로 분석되었다.

1.2.2. 대응

Treemap Report에 대한 대응은 Cloud Report에 대한 대응에 종합적으로 작성하였다.

1.3. Cloud Report

1.3.1. 분석 결과



coverage rate에 따라 class 글자의 색상이 결정되고 average method complexity에 따라 글자의 크기가 결정된다.

더 크고 더 빨간 글자일수록 해당 class가 더 많은 risk를 갖는다는 것을 의미한다.

SpecialEffect class가 가장 크고 빨간 글자로 나타내어졌고, 다른 class에 비해 높은 average method complexity와 낮은 coverage rate를 가지는 것으로 분석되었다.

1.3.2. 대응

```
if(i.getthickness()==1){
    list2.add(new DrawLine(i.getx()+kx[0],i.gety()+ky[0],i.getx()-kx[0],i.gety()-ky[0],temp,i.getthickness(),"shadow"));
    this.addlist(i.getx()+kx[0],i.gety()+ky[0],i.getx()-kx[0],i.gety()-ky[0],temp,i.getthickness(),"line",true);
}
else if(i.getthickness()==5){
    list2.add(new DrawLine(i.getx()+kx[1],i.gety()+ky[1],i.getx()-kx[1],i.gety()-ky[1],temp,i.getthickness(),"shadow"));
    this.addlist(i.getx()+kx[1],i.gety()+ky[1],i.getx()-kx[1],i.gety()-ky[1],temp,i.getthickness(),"line",true);
//필요 추가하는 이유는 점선 처리를 추가
}
else if(i.getthickness()==10){
    list2.add(new DrawLine(i.getx()+kx[2],i.gety()+ky[2],i.getx()-kx[2],i.gety()-ky[2],temp,i.getthickness(),"shadow"));
    this.addlist(i.getx()+kx[2],i.gety()+ky[2],i.getx()-kx[2],i.gety()-ky[2],temp,i.getthickness(),"line",true);
}
else if(i.getthickness()==15){
    list2.add(new DrawLine(i.getx()+kx[3],i.gety()+ky[3],i.getx()-kx[3],i.gety()-ky[3],temp,i.getthickness(),"shadow"));
    this.addlist(i.getx()+kx[3],i.gety()+ky[3],i.getx()-kx[3],i.gety()-ky[3],temp,i.getthickness(),"line",true);
}
else if(i.getthickness()==20){
    list2.add(new DrawLine(i.getx()+kx[4],i.gety()+ky[4],i.getx()-kx[4],i.gety()-ky[4],temp,i.getthickness(),"shadow"));
    this.addlist(i.getx()+kx[4],i.gety()+ky[4],i.getx()-kx[4],i.gety()-ky[4],temp,i.getthickness(),"line",true);
}
```



```
int tempplux = kx[i.getthickness()/5];
int tempplusy = ky[i.getthickness()/5];
list2.add(new DrawLine(i.getx()+tempplux,i.gety()+tempplusy,i.getx()-tempplux,i.gety()-tempplusy,temp,i.getthickness(),"shadow"));
this.addlist(i.getx()+tempplux,i.gety()+tempplusy,i.getx()-tempplux,i.gety()-tempplusy,temp,i.getthickness(),"line",true);
```

SpecialEffect.java 에서 같은 기능을 하지만 if-else로 중첩되어 있는 부분을 위의 그림과 같이 수정하여 complexity가 작아지도록 하였다.

```
switch (linethickness) {
case 1:
    if (sx <= ex && sy <= ey) { //1
        list.add(new DrawLine(sx+1, sy-1, ex+1, ey-1, color, 1));
        list.add(new DrawLine(sx-1, sy+1, ex-1, ey+1, color, 1));
    }
    else if (sx>=ex && sy >= ey) { //2
        list.add(new DrawLine(sx+1, sy-1, ex+1, ey-1, color, 1));
        list.add(new DrawLine(sx-1, sy+1, ex-1, ey+1, color, 1));
    }
    else if (sx <= ex && sy >= ey) { //3
        list.add(new DrawLine(sx-1, sy-1, ex-1, ey-1, color, 1));
        list.add(new DrawLine(sx+1, sy+1, ex+1, ey+1, color, 1));
    }
    else if (sx>=ex && sy <= ey) { //4
        list.add(new DrawLine(sx-1, sy-1, ex-1, ey-1, color, 1));
        list.add(new DrawLine(sx+1, sy+1, ex+1, ey+1, color, 1));
    }
    break;
case 5:
    if (sx <= ex && sy <= ey) { //1
        list.add(new DrawLine(sx+3, sy-3, ex+3, ey-3, color, 2));
        list.add(new DrawLine(sx-3, sy+3, ex-3, ey+3, color, 2));
    }
    else if (sx>=ex && sy >= ey) { //2
        list.add(new DrawLine(sx+3, sy-3, ex+3, ey-3, color, 2));
        list.add(new DrawLine(sx-3, sy+3, ex-3, ey+3, color, 2));
    }
}
```



```
int plusamount = spbound[dividethick-1];
/* 한 두께에 따라서 special DrawLine 효과를 다르게 적용
 * 브러시를 그림에 4가지 점을 좌표에 따라 다르게 적용
 */
if (sx <= ex && sy <= ey) { //1
    list.add(new DrawLine(sx+plusamount, sy-plusamount, ex+plusamount, ey-plusamount, color, dividethick));
    list.add(new DrawLine(sx-plusamount, sy+plusamount, ex-plusamount, ey+plusamount, color, dividethick));
}
else if (sx>=ex && sy >= ey) { //2
    list.add(new DrawLine(sx+plusamount, sy-plusamount, ex+plusamount, ey-plusamount, color, dividethick));
    list.add(new DrawLine(sx-plusamount, sy+plusamount, ex-plusamount, ey+plusamount, color, dividethick));
}
}
```

Drawtool.java 에서는 switch로 나눠져서 중첩되어 있는 부분을 하나로 합쳐 위의 그림과 같이 수정하여 complexity가 작아지도록 하였다.

```

if(state.equals("pencil")) { //연필의 경우
    drawtool.addlist(sx, sy, ex, ey, state);
    getxy(ex,ey);
    sx = ex;
    sy = ey;
}
else if(state.equals("eraser")) { //지우개의 경우
    drawtool.addlist(sx, sy, ex, ey, state);
    getxy(ex,ey);
    sx = ex;
    sy = ey;
}
else if(state.equals("brush")) { //브러시의 경우
    drawtool.addlist(sx, sy, ex, ey, state);
    getxy(ex,ey);
    sx = ex;
    sy = ey;
}
}

```



```

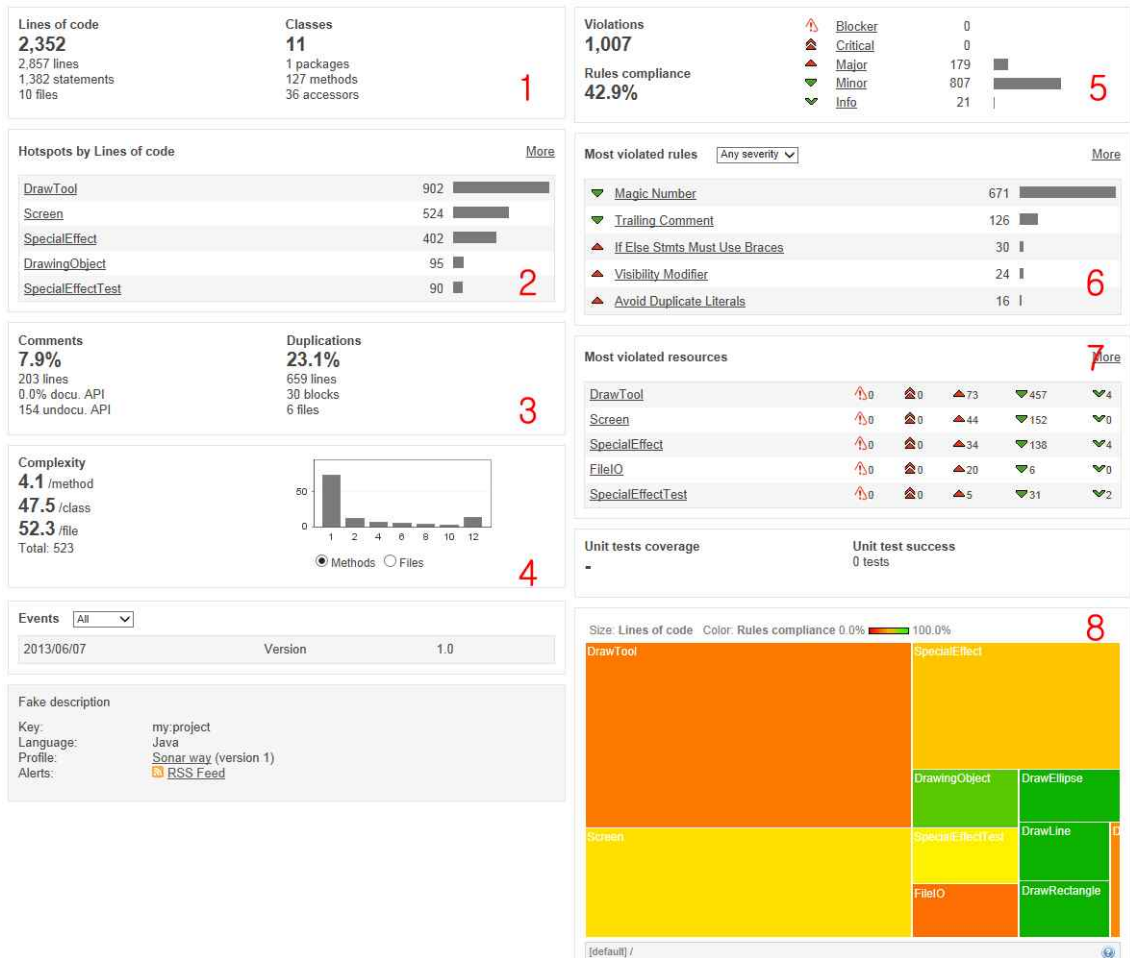
if(state.equals("pencil") || state.equals("eraser") || state.equals("brush")) { //연필, 지우개, 브러시의 경우
    drawtool.addlist(sx, sy, ex, ey, state);
    getxy(ex,ey);
    sx = ex;
    sy = ey;
}
}

```

Screen.java 에서도 마찬가지로 if-else로 중첩되어 있는 부분을 위의 그림과 같이 수정 하였다.

1. Sonar

1.1. 분석 결과



1. 프로젝트에 대한 기본 정보
2. class별 라인 수
3. Comments : 주석 라인 수 / Duplications : 중복된 라인 수
4. Bad Distribution of Complexity
5. No coding standards and Potential bugs
6. Most violated rules
7. Most violated classes
8. Treemap - Size : Lines of codes / Color : Rules compliance

주석을 너무 적게 사용하여 가독성이 떨어지고 중복되는 코드가 많은 것으로 분석 되었다. 또한, Magic Number(아무런 설명 없이 등장하는 수치 상수)와 Trailing comments(//로 시작하는 주석)을 많이 사용한 것으로 분석되었다. 이 외에도 if-else 문에 중괄호를 사용하지 않았고 class의 변수를 private 변수로 선언하지 않은 것으로 분석되어 코드를 다듬을 필요성이 있다고 판단되었다.

1.2. 대응

1.2.1. Major Violations에 대한 수정

- DrawTool

Line	Violated rule	Description
41	Visibility Modifier	Variable 'color' must be private and have accessor methods.
Relevant code	Solution	Modified code
Color color	private으로 수정	private Color color

Line	Violated rule	Description
45	Unused Private Field	Avoid unused private fields such as 'state'
Relevant code	Solution	Modified code
private String state	사용하지 않아서 삭제	

Line	Violated rule	Description
48	Visibility Modifier	Variable 'frame 1' must be private and have accessor method.
Relevant code	Solution	Modified code
final JFrame frame1	private으로 수정	private final JFrame frame1

Line	Violated rule	Description
50	Visibility Modifier	Variable 'list' must be private and have accessor methods.
Relevant code	Solution	Modified code
public ArrayList<Draw Shape> list	private으로 수정	private ArrayList<DrawShape> list

Line	Violated rule	Description
50	Loose coupling	Avoid using implementation types like 'Array List' use the interface instead
Relevant code	Solution	Modified code
public ArrayList<Draw Shape> list	not accept	

Line	Violated rule	Description
51	Visibility Modifier	Variable 'list2' must be private and have ccessor methods.
Relevant code	Solution	Modified code
public ArrayList<Draw Shape> list2	private으로 수정	private ArrayList<DrawShape> list2

Line	Violated rule	Description
------	---------------	-------------

51	Loose coupling	Aviod using implementation types like 'ArrayList' use the interface instead
Relevant code	Solution	Modified code
public ArrayList<Draw Shape> list2	not accept	

Line	Violated rule	Description
54	Visibility Modifier	Variable 'count' must be private and have accessor methods.
Relevant code	Solution	Modified code
int count	private으로 수정	private int count

Line	Violated rule	Description
57	Avoid Duplicate Literals	The String literal "normal" appears 5 times in this file the first occurrence is on line 57
Relevant code	Solution	Modified code
brushShape = "normal"	상태를 나타내는 문자열이므로 not accept	

Line	Violated rule	Description
57	Avoid Duplicate Literals	The String literal "rectangle" appears 5 times in this file the first occurrence is on line 58
Relevant code	Solution	Modified code
figureShape = "rectangle"	상태를 나타내는 문자열이므로 not accept	

Line	Violated rule	Description
90	Cyclomatic Complexity	Cyclomatic Complexity is 19(max allowed is 10)
Relevant code	Solution	Modified code
public void tempaddlist(double sx, double sy, double ex, double ey,String state)	양호하다고 판단하여 not accept	

Line	Violated rule	Description
105	Avoid Duplicate Literals	The String literal "circle" appears 4 times in his file; the first occurrence is on line 105
Relevant code	Solution	Modified code
	상태를 나타내는 문자열이므로 not accept	

Line	Violated rule	Description
------	---------------	-------------

120	Cyclomatic Complexity	Cyclomatic Complexity is 46(max allowed is 10)
Relevant code	Solution	Modified code
public void spBrush2Cal(double sx,double sy,double ex,double ey,int linethickness)	중복되는 code 간소화하여 refactoring 함	
Line	Violated rule	Description
120	Ncss Method Count	The method spBrush2Cal() has an NCSS line count of 87
Relevant code	Solution	Modified code
public void spBrush2Cal(double sx,double sy,double ex,double ey,int linethickness)	주석 추가함	
Line	Violated rule	Description
219	Cyclomatic Complexity	Cyclomatic Complexity is 46(max allowed is 10)
Relevant code	Solution	Modified code
public void spBrush1Cal(double sx,double sy,double ex,double ey,int linethickness)	중복되는 code 간소화하여 refactoring 함	
Line	Violated rule	Description
219	Ncss Method Count	the method spBrush1Cal() has an NCSS line count of 89
Relevant code	Solution	Modified code
public void spBrush1Cal(double sx,double sy,double ex,double ey,int linethickness)	주석 추가함	
Line	Violated rule	Description
220	Unused local variable	Avoid unused local variables such as 'dividethick'
Relevant code	Solution	Modified code
int dividethick	refactoring하여 사용하게 되었음	
Line	Violated rule	Description
396	Avoid commented-out lines of code	This block of commented-out lines of code should be removed
Relevant code	Solution	Modified code
	삭제	

Line	Violated rule	Description
317	Cyclomatic Complexity	Cyclomatic Complexity is 27(max allowed is 10)
Relevant code	Solution	Modified code
public void addlist(double sx,double sy,double ex,double ey,String state)	양호하다고 판단하여 not accept	
Line	Violated rule	Description
437	Local Final Variable Name	Name 'scrollBar_1' must match pattern '^[a-z][a-zA-Z0-9]*\$'
Relevant code	Solution	Modified code
scrollBar_1	변수 이름 수정	scrollBar1
Line	Violated rule	Description
453	Local Final Variable Name	Name 'scrollBar_2' must match pattern '^[a-z][a-zA-Z0-9]*\$'
Relevant code	Solution	Modified code
scrollBar_2	변수 이름 수정	scrollBar2
Line	Violated rule	Description
474	Avoid Duplicate Literals	The String literal "deprecation" appears 19 times in this file; the first occurrence is on line 474
Relevant code	Solution	Modified code
@SuppressWarnings("deprecation")	interface implements시 자동 구현된 code로 not accept	
Line	Violated rule	Description
484	Anon Inner Length	Anonymous inner class length 42 lines(max allowed is 20)
Relevant code	Solution	Modified code
frame.addWindowListener(new WindowListener())	line 수 줄임	
Line	Violated rule	Description
558	Local Variable Name	Name 'btnNewButton_1' must match pattern '^[a-z][a-zA-Z0-9]*\$'
Relevant code	Solution	Modified code
btnNewButton_1	변수 이름 수정	btnNewButton1

Line	Violated rule	Description
584	Anon Inner Length	Anonymos inner class length is 42 lines(max allowed is 20)
Relevant code	Solution	Modified code
frame.addWindowListener(new WindowListener())	line 수 줄임	

Line	Violated rule	Description
647	String Literal Equality	Literal Strings should be compared using equals(), not '=='
Relevant code	Solution	Modified code
if(figureshape == "rectangle")	equals()로 수정	if(figureshape.equals("rectangle"))

Line	Violated rule	Description
656	Local Variable Name	Name 'btnNewButton_1' must match pattern '^[a-z][a-zA-Z0-9]*\$'
Relevant code	Solution	Modified code
btnNewButton_1	변수 이름 수정	btnNewButton1

Line	Violated rule	Description
652	if Else Stmt's Must Use Braces	Avoid using if.. else statements without curly braces
Relevant code	Solution	Modified code
else btnNewButton.setIcon(new ImageIcon("res\\rectan.jpg"));	{추가}	else{ btnNewButton.setIcon(new ImageIcon("res\\rectan.jpg"));

Line	Violated rule	Description
667	String Literal Equality	Literal Strings should be compared using equal(), not '=='
Relevant code	Solution	Modified code
if(figureShape = "circle")	equals()로 바꿈	if(figureShape.equals("circle"))

Line	Violated rule	Description
671	If Else Stmt's Must Use Braces	Avoid using if..else statements without curly braces
Relevant code	Solution	Modified code
else btnNewButton_1.setIcon(new ImageIcon("res\\circle.jpg"));	{추가}	else{ 671 btnNewButton_1.setIcon(new ImageIcon("res\\circle.jpg"));

Line	Violated rule	Description
674	Anon Inner Length	Anonymouse inner class length is 42 lines (max allowed is 20)
Relevant code	Solution	Modified code

frame.addWindowListener(new WindowListener())	line 수 줄임	
---	-----------	--

Line	Violated rule	Description
752	If Else Stmts Must Use Braces	Avoid using if..else statements without curly braces
Relevant code	Solution	Modified code
if(lineThickness == 5) btnNewButton.setIcon(new ImageIcon("res\\Line_5_sel.png"));	{추가}	if(lineThickness == 5){ 752 btnNewButton.setIcon(new ImageIcon("res\\Line_5_sel.png"));

Line	Violated rule	Description
754	If Else Stmt Must Use Braces	Avoid using if..else statements without curly braces
Relevant code	Solution	Modified code
else btnNewButton.setIcon(new ImageIcon("res\\Line_5.png"));	{추가}	else{ btnNewButton.setIcon(new ImageIcon("res\\Line_5.png"));

Line	Violated rule	Description
758	Local Variable Name	Name 'btnNewButton_1' must match pattern '^([a-z][a-zA-Z0-9]*)\$'
Relevant code	Solution	Modified code
btnNewButton_1	변수 이름 수정	btnNewButton1

Line	Violated rule	Description
770	If Else Stmts Must Use Braces	Avoid using if..else statements without curly braces
Relevant code	Solution	Modified code
if(lineThickness == 10) btnNewButton_1.setIcon(new ImageIcon("res\\Line_10_sel.png"));	{추가}	if(lineThickness == 10){ btnNewButton_1.setIcon(new ImageIcon("res\\Line_10_sel.png"));

Line	Violated rule	Description
772	If Else Stmts Must Use Braces	Avoid using if..else statements without curly braces
Relevant code	Solution	Modified code
else btnNewButton_1.setIcon(new ImageIcon("res\\Line_10.png"));	{추가}	else{ btnNewButton_1.setIcon(new ImageIcon("res\\Line_10.png"));

Line	Violated rule	Description
776	Local Variable Name	Name 'btnNewButton_2' must match pattern '^([a-z][a-zA-Z0-9]*)\$'.
Relevant code	Solution	Modified code
btnNewButton_2	변수 이름 수정	btnNewButton2

Line	Violated rule	Description
788	If Else Stmts Must Use Braces	Avoid using if..else statements without curly braces
Relevant code	Solution	Modified code
if(lineThickness == 1) btnNewButton_2.setIcon(new ImageIcon("res\\Line_1_sel.png"));	{추가}	if(lineThickness == 1){ btnNewButton_2.setIcon(new ImageIcon("res\\Line_1_sel.png"));

Line	Violated rule	Description
790	If Else Stmts Must Use Braces	Avoid using if..else statements without curly braces
Relevant code	Solution	Modified code
else btnNewButton_2.setIcon(new ImageIcon("res\\Line_1.png"));	{추가}	else{ btnNewButton_2.setIcon(new ImageIcon("res\\Line_1.png"));

Line	Violated rule	Description
794	Local Variable Name	Name 'btnNewButton_3' must match pattern '^([a-z][a-zA-Z0-9]*)\$'
Relevant code	Solution	Modified code
btnNewButton_3	변수 이름 수정	btnNewButton3

Line	Violated rule	Description
806	If Else Stmts Must Use Braces	Avoid using if..else statements without curly braces
Relevant code	Solution	Modified code
if(lineThickness == 15) btnNewButton_3.setIcon(new ImageIcon("res\\Line_15_sel.png"));	{추가}	if(lineThickness == 15){ btnNewButton_3.setIcon(new ImageIcon("res\\Line_15_sel.png"));

Line	Violated rule	Description
808	If Else Stmts Must Use Braces	Avoid using if..else statements without curly braces
Relevant code	Solution	Modified code
else	{추가}	else{

btnNewButton_3 .setIcon(new ImageIcon("res\ \Line_15.png"));		btnNewButton_3.setIcon(new ImageIcon("res\ \Line_15.png"));}
---	--	--

Line	Violated rule	Description
812	Local Variable Name	Name 'btnNewButton_4' must match pattern '^([a-z][a-zA-Z0-9]*)\$'
Relevant code	Solution	Modified code
btnNewButton_4	변수 이름 수정	btnNewButton4

Line	Violated rule	Description
824	If Else Stmts Must Use Braces	Avoid using if..else statements without curly braces
Relevant code	Solution	Modified code
if(lineThickness == 20) btnNewButton_4 .setIcon(new ImageIcon("res\ \Line_20_sel.pn g"));	{}추가	if(lineThickness == 20){ btnNewButton_4.setIcon(new ImageIcon("res\ \Line_20_sel.png"));}

Line	Violated rule	Description
826	If Else Stmts Must Use Braces	Avoid using if..else statements without curly braces
Relevant code	Solution	Modified code
else btnNewButton_4 .setIcon(new ImageIcon("res\ \Line_20.png"));	{}추가	else{ btnNewButton_4.setIcon(new ImageIcon("res\ \Line_20.png"));}

Line	Violated rule	Description
830	Anon Inner Length	Anonymous inner class length is 42lines(max allowed is 20)
Relevant code	Solution	Modified code
frame10.addWin dowListener(ne w WindowListener (line 수 줄임	

Line	Violated rule	Description
883	Avoid Print Stack Trace	Avoid printStackTrace(); use a logger call instead
Relevant code	Solution	Modified code
e.printStackTrace()	자동 구현된 code로 not accept	

Line	Violated rule	Description
887	Avoid commented-out lines of code	This block of commented-out lines of code should be removed
Relevant code	Solution	Modified code
//y = y - 3;	삭제	

Line	Violated rule	Description
889	Hidden Field	'red' hides a field
Relevant code	Solution	Modified code
int red = (k>>16) & 0xff;	삭제	
Line	Violated rule	Description
890	Hidden Field	'green' hides a field
Relevant code	Solution	Modified code
int green = (k>>8) & 0xff;	삭제	
Line	Violated rule	Description
891	Hidden Field	'blue' hides a field
Relevant code	Solution	Modified code
int blue = (k) & 0xff;	삭제	
Line	Violated rule	Description
897	Visibility Modifier	Variable 'x' must be private and have accessor methods
Relevant code	Solution	Modified code
double x	private으로 수정	private double x
Line	Violated rule	Description
898	Visibility Modifier	Variable 'y' must be private and have accessor methods
Relevant code	Solution	Modified code
double y	private으로 수정	private double y
Line	Violated rule	Description
910	Cyclomatic Complexity	Cyclomatic complexity is 14(max allowed is 10).
Relevant code	Solution	Modified code
public BufferedImage fillDecalColor(int panelx, int panely, int width, int height, Color c)	불필요하여 삭제	
Line	Violated rule	Description
911	Hidden Field	'list' hides a field
Relevant code	Solution	Modified code
ArrayList<temp > list	해당하는 method 불필요하여 삭제	
Line	Violated rule	Description
917	Avoid Print Stack Trace	Avoid printStackTrace(); use a logger call instead
Relevant code	Solution	Modified code
e.printStackTrace()	해당하는 method	

	불필요하여 삭제	
Line	Violated rule	Description
924	Hidden Field	'color' hides a field
Relevant code	Solution	Modified code
int color	해당하는 method 불필요하여 삭제	
Line	Violated rule	Description
927	Unused local variable	Avoid unused local variables such as 'flag'
Relevant code	Solution	Modified code
int flag	해당하는 method 불필요하여 삭제	
Line	Violated rule	Description
958	If Else Stmts Must Use Braces	Avoid using if..else statements without curly braces
Relevant code	Solution	Modified code
else break;	해당하는 method 불필요하여 삭제	
Line	Violated rule	Description
964	Avoid commened-out lines of code	This block of commented-out lines of code shoud be removed
Relevant code	Solution	Modified code
//public BufferedImage decallImage(int start_x, int start_y, int width, int height){	삭제	
Line	Violated rule	Description
971	Avoid Print Stack Trace	Avoid printStackTrace(); use a logger call instead
Relevant code	Solution	Modified code
e.printStackTrace()	자동 구현된 code로 not accept	
Line	Violated rule	Description
981	If Else Stmts Must Use Braces	Avoid using if..else statements without curly braces
Relevant code	Solution	Modified code
if(outImage.getRGB((width/2) - i, j) <= outImage.getRGB((width/2) + i, j)) outImage.setRGB((width/2) + i, j, j,	{추가	if(outImage.getRGB((width/2) - i, j) <= outImage.getRGB((width/2) + i, j)) { outImage.setRGB((width/2) + i, j, outImage.getRGB((width/2) - i, j));}

outImage.getRGB((width/2) - i, j);		
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Line	Violated rule	Description
983	If Else Stmts Must Use Braces	Avoid using if..else statements without curly braces
Relevant code	Solution	Modified code
<pre>else outImage.setRGB((width/2) - i, j, outImage.getRGB((width/2) + i, j));</pre>	{}추가	<pre>else{ outImage.setRGB((width/2) - i, j, outImage.getRGB((width/2) + i, j)};</pre>

Line	Violated rule	Description
984	Avoid commented-out lines of code	This block of commented-out lines of code should be removed
Relevant code	Solution	Modified code
<pre>//if(outImage.getRGB((width/2) - i, j) != outImage.getRGB((width/2) + i, j))</pre>	삭제	

Line	Violated rule	Description
998	Cyclomatic Complexity	Cyclomatic Complexity is 13(max allowed is 10).
Relevant code	Solution	Modified code
<pre>public BufferedImage fillColor(int panelx, int panely,int x, int y,int width, int height,Color c)</pre>	양호하다고 판단하여 not accept	

Line	Violated rule	Description
999	Hidden Field	'list'hides a field
Relevant code	Solution	Modified code
<pre>ArrayList<temp > list</pre>	method 내부에서만 사용하므로 not accept	

Line	Violated rule	Description
1007	Avoid Print Stack Trace	Avoid printStackTrace(); use a logger call instead
Relevant code	Solution	Modified code
<pre>e.printStackTrace()</pre>	자동 구현된 code로 not accept	

Line	Violated rule	Description
1012	Hidden Field	'color' hides a field
Relevant code	Solution	Modified code

int color	method 내부에서만 사용하므로 not accept	
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Line	Violated rule	Description
1018	Unused local variables	Avoid unused local variables such as 'flag'
Relevant code	Solution	Modified code
int flag	삭제	

Line	Violated rule	Description
1049	If Else Stmts Must Use Braces	Avoid using if..els statements without curly braces
Relevant code	Solution	Modified code
else break;	{추가}	else { break; }

Line	Violated rule	Description
1053	Loose coupling	Avoid using implementation types like 'ArrayList'; use the interface instead
Relevant code	Solution	Modified code
public ArrayList<Draw Shape> getlist()	not accept	

Line	Violated rule	Description
1056	Loose coupling	Avoid using implementation types like 'ArrayList'; use the interface instead
Relevant code	Solution	Modified code
public void setlist(ArrayList <DrawShape> list)	not accept	

Line	Violated rule	Description
1059	Loose coupling	Avoid using implementation types like 'ArrayList'; use the interface instead
Relevant code	Solution	Modified code
public void setlist2(ArrayLis t<DrawShape> list)	not accept	

- Screen

Line	Violated rule	Description
44	Visibility Modifier	Variable 'g' must be private and have accessor methods.
Relevant code	Solution	Modified code
Graphics g	사용하지 않아서 삭제	

Line	Violated rule	Description
45	Visibility Modifier	Variable 'mycursor' must be private

		and have accessor methods.
Relevant code	Solution	Modified code
Cursor mycursor	private으로 수정	private Cursor mycursor
Line	Violated rule	Description
46	Visibility Modifier	Variable 'state' must be private and have accessor methods.
Relevant code	Solution	Modified code
public String state	private으로 수정	private String state
Line	Violated rule	Description
46	Avoid Duplicate Literals	The String literal "pencil" appears 7 times in this file; the first occurrence is on line 46
Relevant code	Solution	Modified code
public String state = "pencil";	상태를 나타내는 문자열이므로 not accept	
Line	Violated rule	Description
47	Member name	Name 'X' must match pattern '[a-z][a-zA-Z0-9]*\$'.
Relevant code	Solution	Modified code
[]X	변수 이름 수정	[]xCoordinate
Line	Violated rule	Description
47	Visibility Modifier	Variable 'X' must be private and have accessor methods.
Relevant code	Solution	Modified code
public double []X	private로 수정	private double []xCoordinate
Line	Violated rule	Description
47	Naming - Suspicious constant field name	The field name indicates a constant but its modifiers do not
Relevant code	Solution	Modified code
[]X	변수 이름 수정	[]xCoordinate
Line	Violated rule	Description
48	Member name	Name 'Y' must match pattern '[a-z][a-zA-Z0-9]*\$'.
Relevant code	Solution	Modified code
[]Y	변수 이름 수정	[]yCoordinate
Line	Violated rule	Description
48	Visibility Modifier	Variable 'Y' must be private and have accessor methods.
Relevant code	Solution	Modified code
public double	private으로 수정	private double []yCoordinate

[Y		
Line	Violated rule	Description
48	Naming - Suspicious constant field name	The field name indicates a constant but its modifiers do not
Relevant code	Solution	Modified code
[Y	변수 이름 수정	[yCoordinate
Line	Violated rule	Description
55	Member name	Name 'showcolor_panel' must match pattern '^[a-z][a-zA-Z0-9]*\$'.
Relevant code	Solution	Modified code
showcolor_panel	변수 이름 수정	showColorPanel
Line	Violated rule	Description
55	Visibility Modifier	Variable 'showcolor_panel' must be private and have accessor methods.
Relevant code	Solution	Modified code
Panel showcolor_panel	private로 수정	private Panel showColorPanel
Line	Violated rule	Description
56	Loose coupling	Avoid using implementation types like 'ArrayList'; use the interface instead
Relevant code	Solution	Modified code
private ArrayList<DrawShape> list	not accept	
Line	Violated rule	Description
57	Visibility Modifier	Variable 'txtthick' must be private and have accessor methods.
Relevant code	Solution	Modified code
final JTextPane txtthickJTextPane();	private로 수정	private final JTextPane txtthick
Line	Violated rule	Description
58	Visibility Modifier	Variable 'frame' must be private and have accessor methods.
Relevant code	Solution	Modified code
public JFrame frame	private로 수정	private JFrame frame
Line	Violated rule	Description
59	Member name	Name 'Image3' must match pattern '^[a-z][a-zA-Z0-9]*\$'.

Relevant code	Solution	Modified code
BufferedImage Image3	사용하지 않아서 삭제	
Line	Violated rule	Description
59	Visibility Modifier	Variable 'Image3' must be private and have accessor methods.
Relevant code	Solution	Modified code
BufferedImage Image3	사용하지 않아서 삭제	
Line	Violated rule	Description
60	Visibility Modifier	Variable 'isfillFlag' must be private and have accessor methods.
Relevant code	Solution	Modified code
int isfillFlag	사용하지 않아서 삭제	
Line	Violated rule	Description
61	Visibility Modifier	Variable 'panel' must be private and have accessor methods.
Relevant code	Solution	Modified code
public JPanel panel	private로 수정	private JPanel panel
Line	Violated rule	Description
62	Visibility Modifier	Variable 'c' must be private and have accessor methods.
Relevant code	Solution	Modified code
Container c	private로 수정	private Container c
Line	Violated rule	Description
68	Constructor Calls Overridable Method	Overridable method 'resetxy' called during object construction
Relevant code	Solution	Modified code
public void resetxy()	final로 수정	public final void resetxy()
Line	Violated rule	Description
74	Ncss Method Count	The method initialize() has an NCSS line count of 109
Relevant code	Solution	Modified code
private void initialize()	UI상에서 버튼을 추가하기 위해 같은 기능을 하는 code를 중복 사용하였으므로 주석을 달지 않아서 not accept	
Line	Violated rule	Description
119	Avoid Duplicate Literals	The String literal "deprecation" appears 4 times in this file; the first

		occurrence is on line 119
Relevant code	Solution	Modified code
@SuppressWarnings("deprecation")	interface implements시 자동 구현된 code로 not accept	
Line	Violated rule	Description
171	Local Variable Name	Name 'fill_button' must match pattern '^[a-z][a-zA-Z0-9]*\$'.
Relevant code	Solution	Modified code
fill_button	변수 이름 수정	fillColor
Line	Violated rule	Description
281	Local Variable Name	Name 'showthick_panel' must match pattern '^[a-z][a-zA-Z0-9]*\$'.
Relevant code	Solution	Modified code
showthick_panel	변수 이름 수정	showThickness
Line	Violated rule	Description
298	Local Variable Name	Name 'open_file' must match pattern '^[a-z][a-zA-Z0-9]*\$'.
Relevant code	Solution	Modified code
open_file	변수 이름 수정	openFile
Line	Violated rule	Description
301	Avoid commented-out lines of code	This block of commented-out lines of code should be removed.
Relevant code	Solution	Modified code
// init();	삭제	
Line	Violated rule	Description
312	Local Variable Name	Name 'save_file' must match pattern '^[a-z][a-zA-Z0-9]*\$'.
Relevant code	Solution	Modified code
save_file	변수 이름 수정	saveFile
Line	Violated rule	Description
365	Avoid Duplicate Literals	The String literal "eraser" appears 4 times in this file; the first occurrence is on line 365
Relevant code	Solution	Modified code
state.equals("eraser")	상태를 나타내는 문자열이므로 not accept	
Line	Violated rule	Description
371	Avoid Duplicate Literals	The String literal "brush" appears 5 times in this file; the first occurrence is on line 371
Relevant code	Solution	Modified code
state.equals("b	상태를 나타내는	

rush")	문자열이므로 not accept	
Line	Violated rule	Description
377	Avoid Duplicate Literals	The String literal "shape" appears 4 times in this file; the first occurrence is on line 377
Relevant code	Solution	Modified code
state.equals("shape")	상태를 나타내는 문자열이므로 not accept	
Line	Violated rule	Description
396	Avoid commented-out lines of code	This block of commented-out lines of code should be removed.
Relevant code	Solution	Modified code
//drawtool.setBounds(0,60,frame.getWidth()-16,frame.getHeight()-98);	삭제	
Line	Violated rule	Description
433	Avoid commented-out lines of code	This block of commented-out lines of code should be removed.
Relevant code	Solution	Modified code
//drawtool.setPixelColor(getX(),getY(),sx,sy,drawtool.getWidth(),drawtool.getHeight());	삭제	
Line	Violated rule	Description
481	Local Variable Name	Name 'Image' must match pattern '^([a-z][a-zA-Z0-9]*)\$'.
Relevant code	Solution	Modified code
Image	변수 이름 수정	image
Line	Violated rule	Description
492	Avoid commented-out lines of code	This block of commented-out lines of code should be removed.
Relevant code	Solution	Modified code
//specialeffect.addlist(X, Y, drawtool.getColor(), 5, state);	삭제	

Line	Violated rule	Description
521	Local Variable Name	Name 'Image' must match pattern '^[a-z][a-zA-Z0-9]*\$'.
Relevant code	Solution	Modified code
Image	변수 이름 수정	image
Line	Violated rule	Description
597	String Literal Equality	Literal Strings should be compared using equals(), not '=='.
Relevant code	Solution	Modified code
if(state == "pencil")	equals()로 수정	if(state.equals("pencil"))
Line	Violated rule	Description
602	String Literal Equality	Literal Strings should be compared using equals(), not '=='.
Relevant code	Solution	Modified code
else if(state =="line" state == "shape")	equals()로 수정	else if(state.equals("line") state.equals("shape"))
Line	Violated rule	Description
606	String Literal Equality	Literal Strings should be compared using equals(), not '=='.
Relevant code	Solution	Modified code
else if(state == "pickcolor")	equals()로 수정	else if(state.equals("pickcolor"))
Line	Violated rule	Description
611	String Literal Equality	Literal Strings should be compared using equals(), not '=='.
Relevant code	Solution	Modified code
else if(state == "shadow")	equals()로 수정	else if(state.equals("shadow"))
Line	Violated rule	Description
616	String Literal Equality	Literal Strings should be compared using equals(), not '=='.
Relevant code	Solution	Modified code
else if(state == "brush")	equals()로 수정	else if(state.equals("brush"))
Line	Violated rule	Description
622	If Else Stmts Must Use Braces	Avoid using if...else statements without curly braces
Relevant code	Solution	Modified code
else t=false;	{}추가	else { t=false; }

Line	Violated rule	Description
623	Simplify Boolean Expression	Expression can be simplified.
Relevant code	Solution	Modified code
if(t==true)	==true 삭제	if(t)

- SpecialEffect

Line	Violated rule	Description
25	Loose coupling	Avoid using implementation types like 'ArrayList'; use the interface instead
Relevant code	Solution	Modified code
private ArrayList<DrawingObject> list	not accept	

Line	Violated rule	Description
26	Loose coupling	Avoid using implementation types like 'ArrayList'; use the interface instead
Relevant code	Solution	Modified code
private ArrayList<DrawShape> list1	not accept	

Line	Violated rule	Description
27	Loose coupling	Avoid using implementation types like 'ArrayList'; use the interface instead
Relevant code	Solution	Modified code
private ArrayList<DrawShape> list2	not accept	

Line	Violated rule	Description
33	Avoid Duplicate Literals	The String literal "shape" appears 6 times in this file; the first occurrence is on line 33
Relevant code	Solution	Modified code
state.equals("shape")	상태를 나타내는 문자열이므로 not accept	

Line	Violated rule	Description
37	Avoid Duplicate Literals	The String literal "line" appears 27 times in this file; the first occurrence is on line 37
Relevant code	Solution	Modified code
DrawingObject(sx, sy, sx+width, sy, c, size, "line", flag))	상태를 나타내는 문자열이므로 not accept	

Line	Violated rule	Description
68	If Else Stmts Must Use Braces	Avoid using if..else statements without curly braces
Relevant code	Solution	Modified code
else list.add(new DrawingObject(s x,sy,ex,ey,c,size ,state,flag));	{추가	else{ list.add(new DrawingObject(sx,sy,ex,ey,c,size,state,fla g)};
Line	Violated rule	Description
89	Loose coupling	Avoid using implementation types like 'ArrayList'; use the interface instead
Relevant code	Solution	Modified code
public void setlist(ArrayList <DrawShape> list)	not accept	
Line	Violated rule	Description
92	Loose coupling	Aviod using implementation types like 'ArrayList'; use the interface instead
Relevant code	Solution	Modified code
public void setlist2(ArrayLis t<DrawShape> list)	not accept	
Line	Violated rule	Description
95	Cyclomatic Complexity	Cyclomatic Complexity is 21(max allowed is 10)
Relevant code	Solution	Modified code
public ArrayList<Draw Shape> excutedecal(int x)	양호하다고 판단하여 not accept	
Line	Violated rule	Description
95	Loose coupling	Avoid using implementation types like 'ArrayList'; use the interface instead
Relevant code	Solution	Modified code
public ArrayList<Draw Shape> excutedecal(int x)	not accept	
Line	Violated rule	Description
95	Ncss Method Count	The method excutedecal() has an NCSS line count of 78
Relevant code	Solution	Modified code
public ArrayList<Draw Shape> excutedecal(int x)	주석 추가함	

Line	Violated rule	Description
106	Avoid Duplicate Literals	The String literal "brush" appears 6 times in this file; the first occurrence is on line 106
Relevant code	Solution	Modified code
<code>i.getState().equals("brush")</code>	상태를 나타내는 문자열이므로 not accept	
Line	Violated rule	Description
155	Avoid Duplicate Literals	The String literal "decal" appears 6 times in this file; the first occurrence is on line 155
Relevant code	Solution	Modified code
<code>DrawLine(i.getX(), i.getY(), i.getWidth(), i.getHeight(), i.getColor(), i.getThickness(), "decal", i.getShadow())</code>	상태를 나타내는 문자열이므로 not accept	
Line	Violated rule	Description
171	Avoid Duplicate Literals	The String literal "rectangle" appears 6 times in this file; the first occurrence is on line 171
Relevant code	Solution	Modified code
<code>i.getState().equals("rectangle")</code>	상태를 나타내는 문자열이므로 not accept	
Line	Violated rule	Description
177	Avoid commented-out lines of code	This block of commented-out lines of code should be removed
Relevant code	Solution	Modified code
<code>//double t1 = i.getX() - 2*x - t;</code>	삭제	
Line	Violated rule	Description
187	Avoid Duplicate Literals	The String literal "ellipse" appears 4 times in this file; the first occurrence is on line 187
Relevant code	Solution	Modified code
<code>i.getState().equals("ellipse")</code>	상태를 나타내는 문자열이므로 not accept	
Line	Violated rule	Description
193	Avoid commented-out lines of code	This block of commented-out lines of code should be removed.
Relevant code	Solution	Modified code
<code>//double t1 = i.getX() - 2*x - t;</code>	삭제	

Line	Violated rule	Description
208	Cyclomatic Complexity	Cyclomatic complexity is 22(max allowed is 10).
Relevant code	Solution	Modified code
public void calDotLine(DrawingObject i,int thick)	양호하다고 판단하여 not accept	

Line	Violated rule	Description
208	Ncss Method Count	The metho calDotLine() has an NCSS line count of 74
Relevant code	Solution	Modified code
public void calDotLine(DrawingObject i,int thick)	주석 추가함	

Line	Violated rule	Description
224	If Else Stmts Must Use Braces	Avoid using if..else statements without curly braces
Relevant code	Solution	Modified code
if(i.getstate().equals("brush")) list2.add(new DrawLine(tx,ty,tx+1,ty+1,i.getcolor(),i.getthick(),"shadow"));	{추가	if(i.getstate().equals("brush")){ list2.add(new DrawLine(tx,ty,tx+1,ty+1,i.getcolor(),i.getthick(),"shadow"));

Line	Violated rule	Description
224	Avoid Duplicate Literals	The String literal "shadow" appears 24 times in this file; the first occurrence is on line 224
Relevant code	Solution	Modified code
DrawLine(tx,ty,tx+1,ty+1,i.getcolor(),i.getthick(),"shadow")	상태를 나타내는 문자열이므로 not accept	

Line	Violated rule	Description
226	If Else Stmts Must Use Braces	Avoid using if..else statements without curly braces
Relevant code	Solution	Modified code
else list2.add(new DrawLine(tx,ty,tx+1,ty+1,i.getcolor(),1,"shadow"));	{추가	else{ list2.add(new DrawLine(tx,ty,tx+1,ty+1,i.getcolor(),1,"shadow"));

Line	Violated rule	Description
230	If Else Stmts Must Use Braces	Avoid using if..else statements without curly braces
Relevant code	Solution	Modified code
if(i.getstate().eq	{추가	if(i.getstate().equals("brush")){

<pre> uals("brush")) list2.add(new DrawLine(tx,ty,t x+1,ty+1,i.getcol or(),i.getthick())) ; </pre>		<pre> list2.add(new DrawLine(tx,ty,tx+1,ty+1,i.getcolor(),i.gett hick()));} </pre>
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Line	Violated rule	Description
232	If Else Stmts Must Use Braces	Avoid using if..else statements without curly braces
Relevant code	Solution	Modified code
<pre> else list2.add(new DrawLine(tx,ty,t x+1,ty+1,i.getcol or(),1)); </pre>	{추가}	<pre> else{ list2.add(new DrawLine(tx,ty,tx+1,ty+1,i.getcolor(),1));} </pre>

Line	Violated rule	Description
246	If Else Stmts Must Use Braces	Avoid using if..else statements without curly braces
Relevant code	Solution	Modified code
<pre> if(i.getstate().eq uals("brush")) list2.add(new DrawLine(tx,ty,t x+1,ty+1,i.getcol or(),i.getthick()," shadow")); </pre>	{추가}	<pre> if(i.getstate().equals("brush")){ list2.add(new DrawLine(tx,ty,tx+1,ty+1,i.getcolor(),i.gett hick(),"shadow"));} </pre>

Line	Violated rule	Description
248	If Else Stmts Must Use Braces	Avoid using if..else statements without curly braces
Relevant code	Solution	Modified code
<pre> else list2.add(new DrawLine(tx,ty,t x+1,ty+1,i.getcol or(),1,"shadow")) ; </pre>	{추가}	<pre> else{ list2.add(new DrawLine(tx,ty,tx+1,ty+1,i.getcolor(),1,"sh adow"));} </pre>

Line	Violated rule	Description
252	If Else Stmts Must Use Braces	Avoid using if..else statements without curly braces
Relevant code	Solution	Modified code
<pre> if(i.getstate().eq uals("brush")) list2.add(new DrawLine(tx,ty,t x+1,ty+1,i.getcol or(),i.getthick())) ; </pre>	{추가}	<pre> if(i.getstate().equals("brush")){ list2.add(new DrawLine(tx,ty,tx+1,ty+1,i.getcolor(),i.gett hick()));} </pre>

Line	Violated rule	Description
254	If Else Stmts Must Use Braces	Avoid using if..else statements without curly braces
Relevant code	Solution	Modified code

<pre>else list2.add(new DrawLine(tx,ty,t x+1,ty+1,i.getcol or(),1));</pre>	<p style="text-align: center;">{}추가</p>	<pre>else{ list2.add(new DrawLine(tx,ty,tx+1,ty+1,i.getcolor(),1));}</pre>
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Line	Violated rule	Description
266	For Loops Must Use Braces	Avoid using if..else statements without curly braces
Relevant code	Solution	Modified code
<pre>for(int ch = 0:ch<i.getcurre nsize()-1:ch++) ...</pre>	<p style="text-align: center;">{}추가</p>	<pre>for(int ch = 0:ch<i.getcurrensize()-1:ch++) { ... }</pre>

Line	Violated rule	Description
288	If Else Stmts Must Use Braces	Avoid using if..else statements without curly braces
Relevant code	Solution	Modified code
<pre>else t = k/(thick + 10)</pre>	<p style="text-align: center;">{}추가</p>	<pre>else{ t = k/(thick + 10)}</pre>

Line	Violated rule	Description
307	Loose coupling	Avoid using implementation types like 'ArrayList': use the interface instead
Relevant code	Solution	Modified code
<pre>public ArrayList<Draw Shape> excuteDottedLin e()</pre>	<p style="text-align: center;">not accept</p>	

Line	Violated rule	Description
331	Cyclomatic Complexity	Cyclomatic Complexity is 38
Relevant code	Solution	Modified code
<pre>public ArrayList<Draw Shape> excuteshadow()</pre>	<p style="text-align: center;">중복되는 code 간소화하여 refactoring 함</p>	

Line	Violated rule	Description
331	Loose coupling	Avoid using implementation types like 'ArrayList': use the interface instead
Relevant code	Solution	Modified code
<pre>public ArrayList<Draw Shape> excuteshadow()</pre>	<p style="text-align: center;">not accept</p>	

Line	Violated rule	Description
331	Ncss Method Count	The method excuteshadow() has an NCS line count of 132
Relevant code	Solution	Modified code
public ArrayList<Draw Shape> excuteshadow()	주석 추가함	

- FileIO

Line	Violated rule	Description
25	Visibility Modifier	Variable 'imgs' must be private and have accessor methods.
Relevant code	Solution	Modified code
public Image imgs	사용하지 않아서 삭제	

Line	Violated rule	Description
26	Visibility Modifier	Variable 'buf' must be private and have accessor methods.
Relevant code	Solution	Modified code
public BufferedImage buf	private으로 수정	private BufferedImage buf

Line	Violated rule	Description
36	Avoid commented-out lines of code	This block of commented-out lines of code should be removed.
Relevant code	Solution	Modified code
//Rectangle imageRec = new Rectangle(x+8, y+90,drawtool. getWidth(),dra wtool.getHeig ht())	삭제	

Line	Violated rule	Description
45	Avoid Print Stack Trace	Avoid printStackTrace(); use a logger call instead
Relevant code	Solution	Modified code
e.printStackTrace()	자동 구현된 code로 not accept	

Line	Violated rule	Description
58	Avoid commented-out lines of code	This block of commented-out lines of code should be removed.
Relevant code	Solution	Modified code
//File	삭제	

saveFile = new File(file);		
Line	Violated rule	Description
65	Avoid Print Stack Trace	Avoid printStackTrace(); use a logger call instead
Relevant code	Solution	Modified code
e.printStackTrace()	자동 구현된 code로 not accept	
Line	Violated rule	Description
68	If Stmts Must Use Braces	Avoid using if statements without curly braces
Relevant code	Solution	Modified code
if(dir == null file == null) return;	{}추가	if(dir == null file == null) {return:}
Line	Violated rule	Description
71	Local Variable Name	Name 'SAFILE' must match pattern '^[a-z][a-zA-Z0-9]*\$'
Relevant code	Solution	Modified code
SAFILE	변수 이름 수정	saFile
Line	Violated rule	Description
83	Simplify Boolean Expression	Expression can be simplified
Relevant code	Solution	Modified code
if((name.toLowerCase().endsWith(".jpg")== true))	==true 삭제	if((name.toLowerCase().endsWith(".jpg")))
Line	Violated rule	Description
84	Simplify Boolean Expression	Expression can be simplified
Relevant code	Solution	Modified code
if((name.toLowerCase().endsWith(".gif")== true))	==true 삭제	if((name.toLowerCase().endsWith(".gif")))
Line	Violated rule	Description
85	If Else Stmts Must Use Braces	Avoid using if..else statements without curly braces
Relevant code	Solution	Modified code
if(...) isaccpet = true;	{}추가	if(...) {isaccpet = true;}

Line	Violated rule	Description
87	If Else Stmts Must Use Braces	Avoid using if...else statements without curly braces
Relevant code	Solution	Modified code
else isaccpet = false;	{}추가	else {isaccpet = false;}
Line	Violated rule	Description
94	Loose coupling	Avoid using implementation types like 'ArrayList'; use the interface instead
Relevant code	Solution	Modified code
ArrayList<DrawShape> list	not accept	
Line	Violated rule	Description
102	If Stmts Must Use Braces	Avoid using if statements without curly braces
Relevant code	Solution	Modified code
if(directory == null filename ==null) return;	{}추가	if(directory == null filename ==null) { return; }
Line	Violated rule	Description
105	Simplify Boolean Expression	Expression can be simplified
Relevant code	Solution	Modified code
if(ok == true)	==true 삭제	if(ok)
Line	Violated rule	Description
112	Parameter Assignment	Assignment of parameter 'list' is not allowed.
Relevant code	Solution	Modified code
list = new ArrayList<DrawShape>()	문제 안 생기므로 not accept	
Line	Violated rule	Description
120	Avoid Print Stack Trace	Avoid printStackTrace(); use a logger call instead
Relevant code	Solution	Modified code
e.printStackTrace()	자동 구현된 code로 not accept	

Line	Violated rule	Description
124	If Else Stmts Must Use Braces	Avoid using if..else statements without curly braces
Relevant code	Solution	Modified code
else JOptionPane.s howMessageDi alog(...)	{}추가	else {JOptionPane.showMessageDialog(...)}

- DrawingObject

Line	Violated rule	Description
21	Unused Private Field	Avoid unused private fields such as 'brushShape'.
Relevant code	Solution	Modified code
private String brushShape	사용하지 않아서 삭제	

Line	Violated rule	Description
22	Unused Private Field	Avoid unused private fields such as 'figureShape'.
Relevant code	Solution	Modified code
private String figureShape	사용하지 않아서 삭제	

Line	Violated rule	Description
40	Constructor Calls Overridable Method	Overridable method 'getsize' called during object construction
Relevant code	Solution	Modified code
public int getsize(double [] x)	final로 수정	public final int getsize(double[] x)

- SpecialEffectTest

Unit Test를 위한 resource이므로 not accept

1.2.2. 중복 코드 refactoring

Treemap Report, Cloud Report에 대한 대응에서와 마찬가지로 if-else나 switch문으로 나뉘어져서 중첩되어 있는 부분을 하나로 합쳐서 refactoring 하였다.

1.2.3. 주석 추가

```

while(true){ //리스트에 추가 될때까지 반복
    if(color == c.getRGB()) {
        break;
    }

    if(!list.isEmpty()){ //목록의 조건을 리스트가 비어있을때
        if(list.get(0).getx() > 0 && list.get(0).gety() > 0 && list.get(0).getx() < width-1 && list.get(0).gety() < height-1){
            double k = list.get(0).getx();
            double l = list.get(0).gety();

            if(outImage.getRGB((int)k+1, (int)l) == color){
                list.add(new temp(k+1.0, l));
                outImage.setRGB((int)k+1, (int)l, c.getRGB());
            }
            if(outImage.getRGB((int)k-1, (int)l) == color){
                list.add(new temp(k-1.0, l));
                outImage.setRGB((int)k-1, (int)l, c.getRGB());
            }
            if(outImage.getRGB((int)k, (int)l+1) == color){
                list.add(new temp(k, l+1.0));
                outImage.setRGB((int)k, (int)l+1, c.getRGB());
            }
            if(outImage.getRGB((int)k, (int)l-1) == color){
                list.add(new temp(k, l-1.0));
                outImage.setRGB((int)k, (int)l-1, c.getRGB());
            }
        }
        list.remove(0);
    }
}

```



```

if(list.get(0).getx() > 0 && list.get(0).gety() > 0 && list.get(0).getx() < width-1 && list.get(0).gety() < height-1){
    //조건을 벗어나지 않는 범위 내에서
    double k = list.get(0).getx(); //x, y 값
    double l = list.get(0).gety();

    /*
     * 위에서 가져온 점의 좌표 상 하 좌 우 방향의 색을 비교함
     * 정확히 같지 않을 경우
     * 리스트에 추가함
     * 조건을 만족하고 점의 좌표 값을 갱신
     */

    if(outImage.getRGB((int)k+1, (int)l) == color){ //좌우에 같지 않으면
        list.add(new temp(k+1.0, l)); //리스트에 추가함
        outImage.setRGB((int)k+1, (int)l, c.getRGB()); //색 변경
    }
    if(outImage.getRGB((int)k-1, (int)l) == color){
        list.add(new temp(k-1.0, l));
        outImage.setRGB((int)k-1, (int)l, c.getRGB());
    }
    if(outImage.getRGB((int)k, (int)l+1) == color){
        list.add(new temp(k, l+1.0));
        outImage.setRGB((int)k, (int)l+1, c.getRGB());
    }
    if(outImage.getRGB((int)k, (int)l-1) == color){
        list.add(new temp(k, l-1.0));
        outImage.setRGB((int)k, (int)l-1, c.getRGB());
    }
}
list.remove(0); //조건을 만족하였던 점 제거 새로 채워(중요)

```


1.2.4. Magic Number의 사용 자제

```
int []kx;
int []ky;
kx = new int[5];
ky = new int[5];
Color temp = new Color(210,210,210);
if(lightxy == 1) {
    kx[0] = 3; kx[1] = 7; kx[2] = 11; kx[3] = 15; kx[4] = 19;
    ky[0] = 3; ky[1] = 7; ky[2] = 11; ky[3] = 15; ky[4] = 19;
}
else if(lightxy == 2) {
    kx[0] = -3; kx[1] = -7; kx[2] = -11; kx[3] = -15; kx[4] = -19;
    ky[0] = 3; ky[1] = 7; ky[2] = 11; ky[3] = 15; ky[4] = 19;
}
else if(lightxy == 3) {
    kx[0] = 3; kx[1] = 7; kx[2] = 11; kx[3] = 15; kx[4] = 19;
    ky[0] = -3; ky[1] = -7; ky[2] = -11; ky[3] = -15; ky[4] = -19;
}
else if(lightxy == 4) {
    kx[0] = -3; kx[1] = -7; kx[2] = -11; kx[3] = -15; kx[4] = -19;
    ky[0] = -3; ky[1] = -7; ky[2] = -11; ky[3] = -15; ky[4] = -19;
}
```

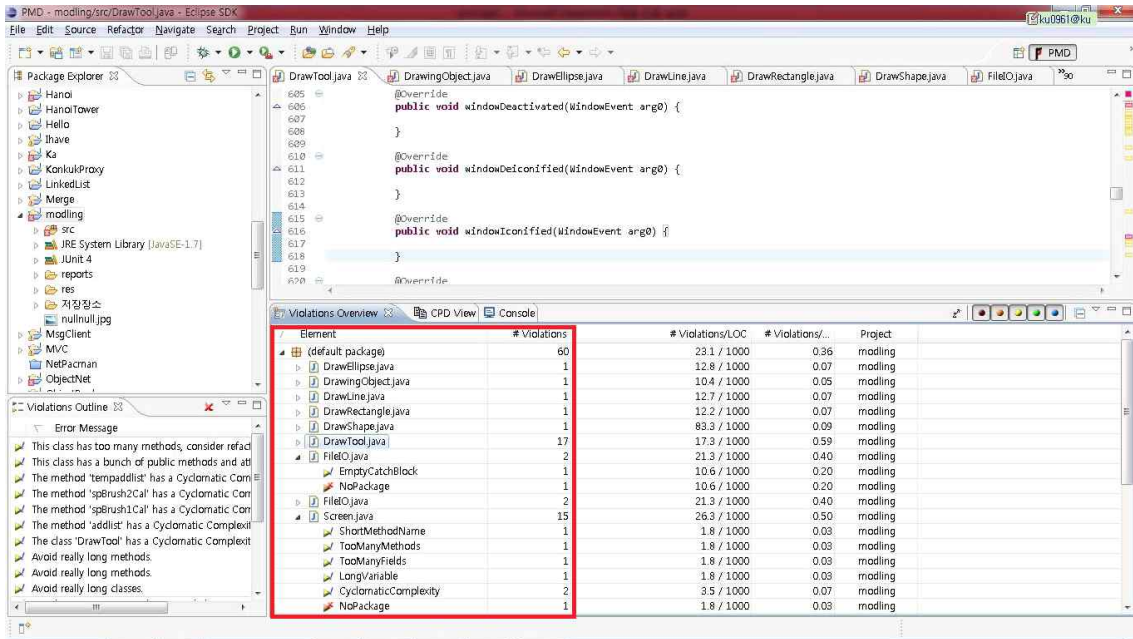


```
int []kx = {3,7,11,15,19};
int []ky = {3,7,11,15,19}; //공통 위치에 따라서 그림자 위치 조절 가능
Color temp = new Color(210,210,210); //형식 만드는 상수
//공통 위치에 따라서 조절 위치 상수 설정
if(lightxy == 2) {
    for(int i = 0; i < 5; i++) {
        kx[i] = -kx[i];
    }
}
else if(lightxy == 3) {
    for(int i = 0; i < 5; i++) {
        ky[i] = -ky[i];
    }
}
else if(lightxy == 4) {
    for(int i = 0; i < 5; i++){
        kx[i] = -kx[i];
        ky[i] = -ky[i];
    }
}
```

위의 그림과 같이 Magic Number의 사용을 최대한으로 줄였다.

2. PMD

2.1. 분석 결과



DrawTool.java	17	17.3 / 1000	0.59	modling
FileO.java	2	21.3 / 1000	0.40	modling
EmptyCatchBlock	1	10.6 / 1000	0.20	modling
NoPackage	1	10.6 / 1000	0.20	modling
FileO.java	2	21.3 / 1000	0.40	modling
Screen.java	15	26.3 / 1000	0.50	modling
ShortMethodName	1	1.8 / 1000	0.03	modling
TooManyMethods	1	1.8 / 1000	0.03	modling
TooManyFields	1	1.8 / 1000	0.03	modling
LongVariable	1	1.8 / 1000	0.03	modling
CyclomaticComplexity	2	3.5 / 1000	0.07	modling
NoPackage	1	1.8 / 1000	0.03	modling

패키지 이름을 설정하지 않았거나 빈 CatchBlock 사용, 짧은 메소드 이름 사용, 너무 많은 메소드 사용, 너무 많은 변수 사용, 긴 변수 이름 사용, 높은 Cyclomatic Complexity 등이 문제로 분석되었다.

2.2. 대응

#	File	Line	Problem	Solution
1	src/DrawEllipse.java	4	All classes and interfaces must belong to a named package	하나의 패키지로 구성해서 따로 이름을 정하지 않았으므로 not accept
2	src/DrawLine.java	4	All classes and interfaces must belong to a named package	하나의 패키지로 구성해서 따로 이름을 정하지 않았으므로 not accept
3	src/DrawRectangle.java	5	All classes and interfaces must belong to a named package	하나의 패키지로 구성해서 따로 이름을 정하지 않았으므로 not accept

4	src/DrawShape.java	4	All classes and interfaces must belong to a named package	하나의 패키지로 구성해서 따로 이름을 정하지 않았으므로 not accept
5	src/DrawTool.java	1	This class has a bunch of public methods and attributes	public으로 선언한 변수가 다소 있어서 private로 수정
6	src/DrawTool.java	40	All classes and interfaces must belong to a named package	하나의 패키지로 구성해서 따로 이름을 정하지 않았으므로 not accept
7	src/DrawTool.java	40	Avoid really long classes.	code 간소화하여 300 lines 정도 줄임
8	src/DrawTool.java	40	The class 'DrawTool' has a Cyclomatic Complexity of 9 (Highest = 46).	중복되는 code 간소화하여 refactoring 함
9	src/DrawTool.java	40	This class has too many methods, consider refactoring it.	불필요한 method 삭제하여 refactoring 함
10	src/DrawTool.java	90	The method 'tempaddlist' has a Cyclomatic Complexity of 19.	code 검토 후 Cyclomatic Complexity가 적정하다고 판단하여 수정하지 않았음
11	src/DrawTool.java	120	The method 'spBrush2Cal' has a Cyclomatic Complexity of 46.	중복되는 code 간소화하여 refactoring 함
12	src/DrawTool.java	219	The method 'spBrush1Cal' has a Cyclomatic Complexity of 46.	중복되는 code 간소화하여 refactoring 함
13	src/DrawTool.java	317	The method 'addlist' has a Cyclomatic Complexity of 27.	code 검토 후 Cyclomatic Complexity가 적정하다고 판단하여 수정하지 않았음
14	src/DrawTool.java	384	Avoid really long methods.	UI구성하는 code로서 길어질 수밖에 없게 되어 not accept
15	src/DrawTool.java	732	Avoid really long methods.	UI구성하는 code로서 길어질 수밖에 없게 되어 not accept
16	src/DrawTool.java	896	All classes and interfaces must belong to a named package	하나의 패키지로 구성해서 따로 이름을 정하지 않았으므로 not accept
17	src/DrawTool.java	926	Avoid instantiating new objects inside loops	필요한 code이므로 not accept
18	src/DrawTool.java	940	Avoid instantiating new objects inside loops	필요한 code이므로 not accept
19	src/DrawTool.java	944	Avoid instantiating new objects inside loops	필요한 code이므로 not accept
20	src/DrawTool.java	948	Avoid instantiating new objects inside loops	필요한 code이므로 not accept
21	src/DrawTool.java	952	Avoid instantiating new objects inside loops	필요한 code이므로 not accept
22	src/DrawingObject.java	18	All classes and interfaces must belong to a named package	하나의 패키지로 구성해서 따로 이름을 정하지 않았으므로 not accept
23	src/FileIO.java	24	All classes and interfaces must belong to a named package	하나의 패키지로 구성해서 따로 이름을 정하지 않았으므로 not accept
24	src/FileIO.java	73	Avoid empty catch blocks	interface implements시 자동

				구현된 코드이므로 not accept
25	src/Screen.java	15	This class has a bunch of public methods and attributes	public으로 선언한 변수가 다소 있어서 private로 수정
26	src/Screen.java	39	All classes and interfaces must belong to a named package	하나의 패키지로 구성해서 따로 이름을 정하지 않았으므로 not accept
27	src/Screen.java	39	The class 'Screen' has a Cyclomatic Complexity of 3 (Highest = 16).	중복되는 code 간소화하여 refactoring 함
28	src/Screen.java	39	This class has too many methods, consider refactoring it.	불필요한 method 삭제하여 refactoring 함
29	src/Screen.java	39	Too many fields	사용하지 않는 변수 삭제하여 최대한으로 줄임
30	src/Screen.java	47	The field name indicates a constant but its modifiers do not	변수 이름 수정
31	src/Screen.java	48	The field name indicates a constant but its modifiers do not	변수 이름 수정
32	src/Screen.java	55	Variables that are not final should not contain underscores (except for underscores in standard prefix/suffix).	변수 이름 수정
33	src/Screen.java	59	Variables should start with a lowercase character	변수 이름 수정
34	src/Screen.java	74	Avoid really long methods.	UI구성하는 code로서 길어질 수밖에 없게 되어 not accept
35	src/Screen.java	74	The method 'initialize' has a Cyclomatic Complexity of 16.	code 검토 후 Cyclomatic Complexity가 적정하다고 판단하여 수정하지 않았음
36	src/Screen.java	74	The method initialize() has an NCSS line count of 109	UI상에서 버튼을 추가하기 위해 같은 기능을 하는 code를 중복 사용하였으므로 주석을 달지 않아서 not accept
37	src/Screen.java	217	Avoid excessively long variable names like selectLineThickness	변수 이름 수정
38	src/Screen.java	399	Do not add empty strings	empty string 삭제
39	src/Screen.java	525	Avoid using short method names	해당 method 불필요하여 삭제
40	src/SpecialEffect.java	19	All classes and interfaces must belong to a named package	하나의 패키지로 구성해서 따로 이름을 정하지 않았으므로 not accept
41	src/SpecialEffect.java	19	The class 'SpecialEffect' has a Cyclomatic Complexity of 10 (Highest = 38).	중복되는 code 간소화하여 refactoring 함
42	src/SpecialEffect.java	31	The method 'addlist' has a Cyclomatic Complexity of 10.	중복되는 code 간소화하여 refactoring 함
43	src/Special	95	Avoid really long methods.	설계한 사항을 반영한 code로

	Effect.java			서 line 수를 크게 줄일 수 없었음
44	src/SpecialEffect.java	95	The method 'excutedecal' has a Cyclomatic Complexity of 21.	code 검토 후 Cyclomatic Complexity가 적정하다고 판단하여 수정하지 않았음
45	src/SpecialEffect.java	95	The method excutedecal() has an NPath complexity of 220	설계한 사항을 반영한 code로서 수정할 수 없었음
46	src/SpecialEffect.java	108	Avoid instantiating new objects inside loops	필요한 code이므로 not accept
47	src/SpecialEffect.java	109	Avoid instantiating new objects inside loops	필요한 code이므로 not accept
48	src/SpecialEffect.java	110	Avoid instantiating new objects inside loops	필요한 code이므로 not accept
49	src/SpecialEffect.java	111	Avoid instantiating new objects inside loops	필요한 code이므로 not accept
50	src/SpecialEffect.java	128	Avoid instantiating new objects inside loops	필요한 code이므로 not accept
51	src/SpecialEffect.java	208	The method 'calDotLine' has a Cyclomatic Complexity of 22.	중복되는 code 간소화하여 refactoring 함
52	src/SpecialEffect.java	331	Avoid really long methods.	설계한 사항을 반영한 code로서 line 수를 크게 줄일 수 없었음
53	src/SpecialEffect.java	331	The method 'excuteshadow' has a Cyclomatic Complexity of 38.	중복되는 code 간소화하여 refactoring 함
54	src/SpecialEffect.java	331	The method excuteshadow() has an NCSS line count of 132	주석 추가함
55	src/SpecialEffect.java	331	The method excuteshadow() has an NPath complexity of 1170	중복되는 code 간소화하여 refactoring 함
56	src/SpecialEffectTest.java	18	All classes and interfaces must belong to a named package	하나의 패키지로 구성해서 따로 이름을 정하지 않았으므로 not accept
57	src/SpecialEffectTest.java	26	Overriding method merely calls super	Unit Test를 위한 code이므로 not accept
58	src/SpecialEffectTest.java	30	Overriding method merely calls super	Unit Test를 위한 code이므로 not accept