

2015. 05. 04

# Vending Machine

## Cadence SMV

건국대학교 일반대학원  
IT융합 정보보호학과

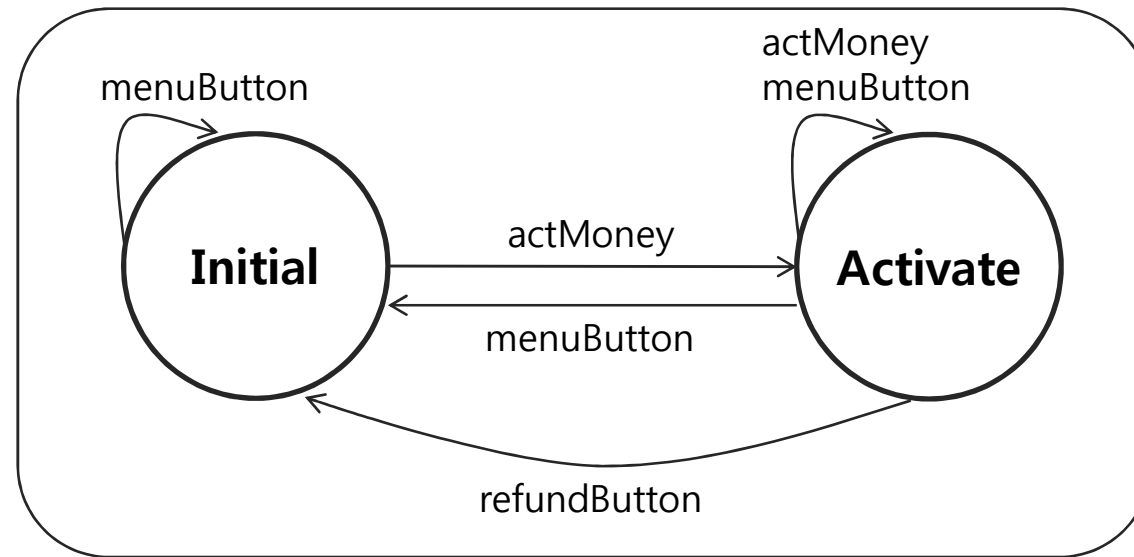
석사과정 김준태, 허응

■ **01 Automata**

■ **02 Definition**

■ **03 Property**

# 01 Automata

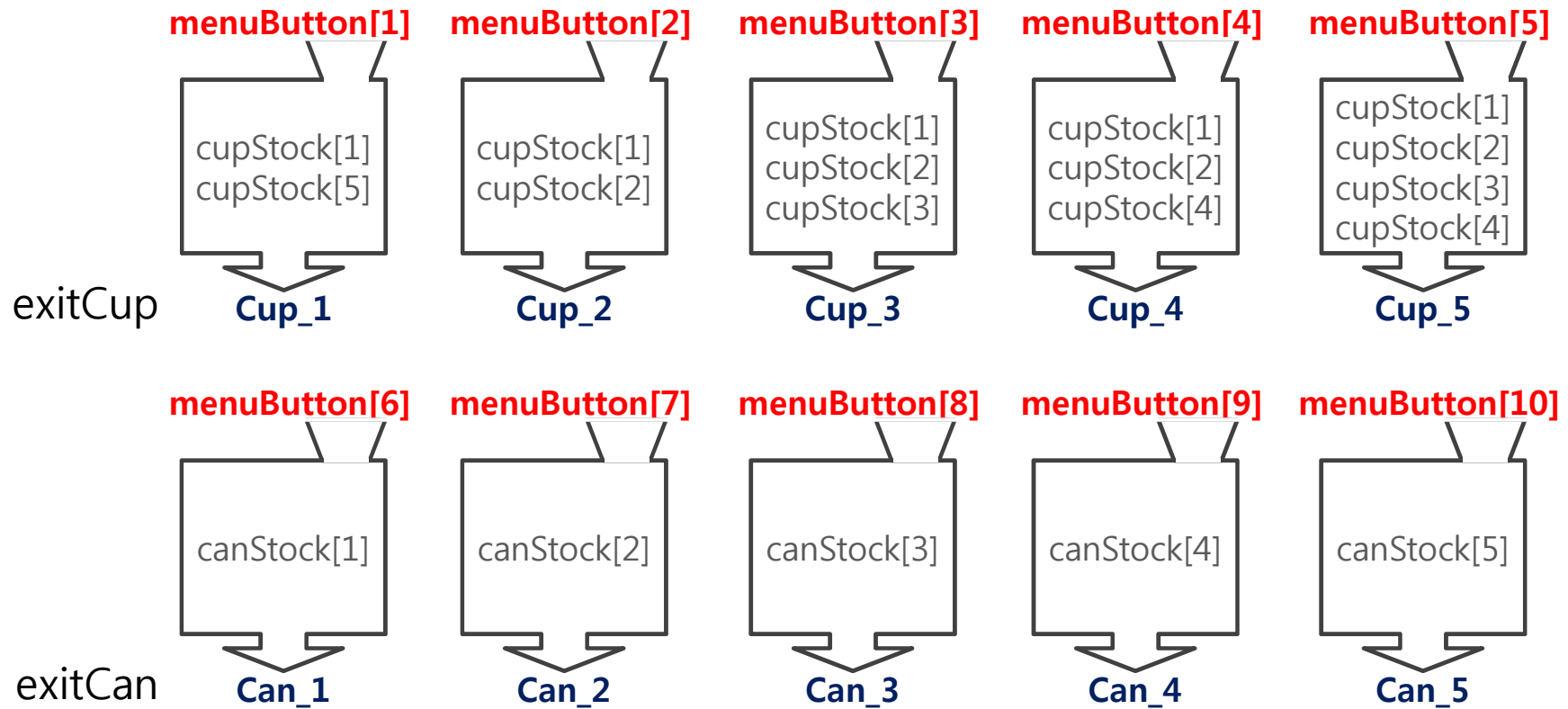


## 02 Definition

- **State**
  - disMoney
  - lampState – 10EA
  - exitCan – 5EA
  - exitCup – 5EA
  - o\_50,o\_100,o\_500,o\_1000
- **Transition Label**
  - actMoney : 0, i\_50, i\_100, i\_500, i\_1000
  - menuButton – 10EA
  - refundButton

## 02 Definition

- 상품 소모 방식



## 03 Property

- **test0 : SPEC AG EX 1; :: DeadLock 검증**
- **test1 : SPEC AG(totalMoney = 1200 & ~tmp1000 & refundButton & menuButton[1] & actMoney = 0 & ~(menuButton[2] | menuButton[3] | menuButton[4] | menuButton[5] | menuButton[6] | menuButton[7] | menuButton[8] | menuButton[9] | menuButton[10]) -> AX(disMoney = 0 & exitCup = 0 & o\_50 = 0 & o\_100 = 2 & o\_500 = 2 & o\_1000 = 0));**  
:: 지폐 없이 1200원을 투입한 상태에서 반환버튼과 음료버튼 동시에 누르면 다음 상태에서 음료는 나오지 않고 돈은 500원 2개, 100원 2개가 반환이 되며 투입금액은 0원이 된다.
- **test2 : SPEC AG(totalMoney = 450 & menuButton[6] & ~refundButton & actMoney = 0 & ~(menuButton[1] | menuButton[2] | menuButton[3] | menuButton[4] | menuButton[5] | menuButton[7] | menuButton[8] | menuButton[9] | menuButton[10]) -> AX(disMoney = 450 & exitCan = 0));**  
:: 450원 투입한 상태에서 500원짜리인 음료의 버튼을 누를 시 다음 상태는 변화 없음.
- **test3 : SPEC AG(totalMoney = 700 & menuButton[1] & menuButton[7] & ~refundButton & actMoney = 0 & ~(menuButton[2] | menuButton[3] | menuButton[4] | menuButton[5] | menuButton[6] | menuButton[8] | menuButton[9] | menuButton[10]) -> AX(disMoney = 700 & exitCan = 0 & exitCup = 0));**  
:: 700원 투입한 상태에서 메뉴버튼 두개를 동시에 누를 시 다음 상태는 변화 없음.

## 03 Property

- **test4** : SPEC AG(**totalMoney = 500 & cupStock[1] = 0 & menuButton[4]** & ~refundButton & actMoney = 0 & ~(menuButton[1] | menuButton[2] | menuButton[3] | menuButton[5] | menuButton[6] | menuButton[7] | menuButton[8] | menuButton[9] | menuButton[10])  
-> **AX(disMoney = 500 & exitCup = 0)**);  
:: 500원 투입한 상태에서 cupStock[1] 재료가 하나도 없을 때 컵 메뉴와 관련된 버튼을 누를 시 다음 상태는 변화 없음.
- **test5** : SPEC AG(**totalMoney = 0 & menuButton[9]** & ~refundButton & actMoney = 0 & ~(menuButton[1] | menuButton[2] | menuButton[3] | menuButton[4] | menuButton[5] | menuButton[6] | menuButton[7] | menuButton[8] | menuButton[10])  
-> **AX(disMoney = 1000)**);  
:: 돈을 넣지 않은 상황에서 버튼을 누를 시 다음 상태에는 버튼에 해당하는 메뉴의 금액이 표시됨.
- **test6** : SPEC AG(**totalMoney = 1200 & canStock[5] = 2 & menuButton[10]** & ~refundButton & actMoney = 0 & ~(menuButton[1] | menuButton[2] | menuButton[3] | menuButton[4] | menuButton[5] | menuButton[6] | menuButton[7] | menuButton[8] | menuButton[9])  
-> **AX(disMoney = 0 & exitCan = Can\_5 & state = initial)**);  
:: 1200원 투입한 상태에서 해당메뉴의 재고가 있을 때 버튼을 누를 시 다음 상태에서 금액은 0원으로 변하면서 initial상태가 되고 원하는 메뉴가 출구에서 나옴.

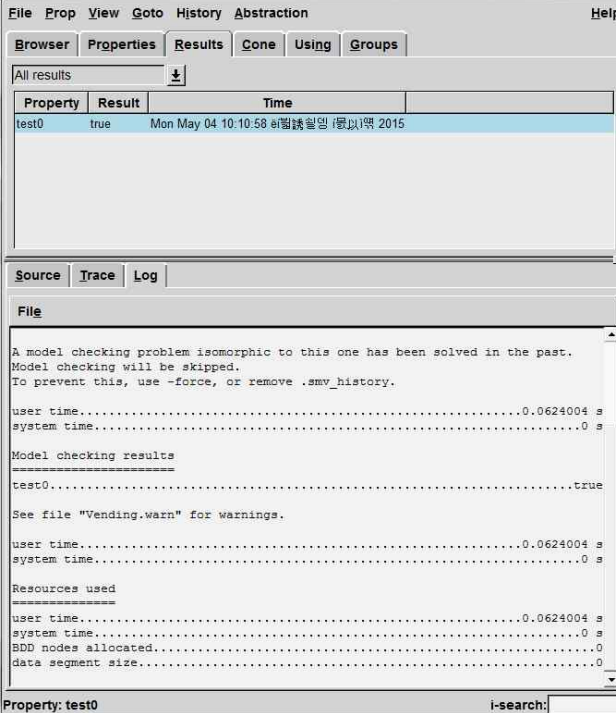
## 03 Property

- **test7** : SPEC AG(**totalMoney = 4050 & actMoney = i\_1000** & ~refundButton & ~(menuButton[1] | menuButton[2] | menuButton[3] | menuButton[4] | menuButton[5] | menuButton[6] | menuButton[7] | menuButton[8] | menuButton[9] | menuButton[10]))  
-> **AX(disMoney = 4050 & o\_1000 = 1)**);  
:: 4050원 투입한 상태에서 1000원짜리를 추가 투입하면 다음 상태에서 disMoney는 유지되면서 추가 투입한 1000원은 반환됨.
- **test8** : SPEC AG(**totalMoney = 500 & cupStock[1] = 1 & menuButton[5]** & ~refundButton & actMoney = 0 & ~(menuButton[1] | menuButton[2] | menuButton[3] | menuButton[4] | menuButton[6] | menuButton[7] | menuButton[8] | menuButton[9] | menuButton[10]))  
-> **AX(disMoney = 200 & exitCup = Cup\_5 & lampState[1] = err & lampState[2] = err & lampState[3] = err & lampState[4] = err & lampState[5] = err)**);  
:: 500원이 투입되어있고 cupStock[1]의 재고가 하나 남았을 시 5번 버튼을 누르면 다음 상태에서 200원이 남고 5번 버튼에 해당되는 상품이 나오며 cupStock[1]의 재료가 필요한 1~5번 메뉴의 lampState는 모두 err상태가 됨.
- **test9** : SPEC AG(**totalMoney = 150 & lampState[1] = err & menuButton[1]** & ~refundButton & actMoney = 0 & ~(menuButton[2] | menuButton[3] | menuButton[4] | menuButton[5] | menuButton[6] | menuButton[7] | menuButton[8] | menuButton[9] | menuButton[10]))-  
> **AX(disMoney = 150 & exitCup = 0)**);  
:: 250원이 투입되어 있고 lampState[1]이 err상태일 때 1번 버튼을 누르면 다음 상태는 변화 없음.



## 03 Property – test0

- test0 : SPEC AG EX 1; :: DeadLock 검증



The screenshot shows a software interface with a menu bar (File, Prop, View, Goto, History, Abstraction, Help) and several tabs (Browser, Properties, Results, Cone, Using, Groups). The 'Results' tab is active, displaying a table with columns 'Property', 'Result', and 'Time'. The table contains one entry: 'test0' with 'true' as the result and a timestamp 'Mon May 04 10:10:58 aM 2015'. Below the table are tabs for 'Source', 'Trace', and 'Log'. The 'Log' tab is selected, showing a text area with the following content:

```
File
-----
A model checking problem isomorphic to this one has been solved in the past.
Model checking will be skipped.
To prevent this, use -force, or remove .smv_history.

user time.....0.0624004 s
system time.....0 s

Model checking results
=====
test0.....true

See file "Vending.warn" for warnings.

user time.....0.0624004 s
system time.....0 s

Resources used
=====
user time.....0.0624004 s
system time.....0 s
BDD nodes allocated.....0
data segment size.....0

Property: test0      i-search:
```

## 03 Property – test1

- **test1** : SPEC AG(**totalMoney = 1200 & ~tmp1000 & refundButton & menuButton[1]** & actMoney = 0 & ~(menuButton[2] | menuButton[3] | menuButton[4] | menuButton[5] | menuButton[6] | menuButton[7] | menuButton[8] | menuButton[9] | menuButton[10])  
-> **AX(disMoney = 0 & exitCup = 0 & o\_50 = 0 & o\_100 = 2 & o\_500 = 2 & o\_1000 = 0));**

### State

- disMoney = 1200 ( 1000원 사용 안함 )

### Transition label

- refundButton
- menuButton[1]



### State

- disMoney = 0
- exitCup = 0
- o\_50 = 0
- o\_100 = 2
- o\_500 = 2
- o\_1000 = 0

The screenshot shows a model checker window with the following content:

- File Prop View Goto History Abstraction Help
- Browser Properties Results Cone Using Groups
- All results
- Table with columns: Property, Result, Time
- test1 true Thu Apr 30 21:04:47 6월 14일 2015
- Source Trace Log
- File
- reached states BDD size.....8463
- iteration 36.....39
- user time.....61.1524 s
- system time.....0.0624004 s
- Model checking time: 61.011991
- user time.....61.1524 s
- system time.....0.0780005 s
- Model checking results
- =====
- test1.....true
- See file "Vending.warn" for warnings.
- user time.....61.1524 s
- system time.....0.0780005 s
- Resources used
- =====
- user time.....61.1524 s
- system time.....0.0780005 s
- BDD nodes allocated.....1784859
- data segment size.....0
- Property: test1
- i-search:

## 03 Property – test1

- **test1** : SPEC AG(**totalMoney = 1200 & ~tmp1000 & refundButton & menuButton[1]** & actMoney = 0 & ~(menuButton[2] | menuButton[3] | menuButton[4] | menuButton[5] | menuButton[6] | menuButton[7] | menuButton[8] | menuButton[9] | menuButton[10])  
-> **AX(disMoney = 50 & exitCup = 0 & o\_50 = 0 & o\_100 = 2 & o\_500 = 2 & o\_1000 = 0)**);

### State

- disMoney = 1200 ( 1000원 사용 안함 )

### Transition label

- refundButton
- menuButton[1]



### State

- **disMoney = 0 ( 50 )**
- exitCup = 0
- o\_50 = 0
- o\_100 = 2
- o\_500 = 2
- o\_1000 = 0

The screenshot shows a software tool interface with a menu bar (File, Prop, View, Goto, History, Abstraction, Help) and a toolbar (Browser, Properties, Results, Cone, Using, Groups). The main area displays test results for 'test2' with a 'Property' column containing 'false' and a 'Time' column showing 'Thu Apr 30 22:37:12 KST 2015'. Below this is a 'Source | Trace | Log' section and a 'File Edit Run View' menu. The main content is a table with columns 1-5 and rows for variables: actMoney, disMoney, exitCan, exitCup, menuButton[1], menuButton[6], and state. The state row shows 'initial' in column 1 and 'activat' in columns 2-5.

	1	2	3	4	5
actMoney	i_500	0	i_100	0	0
disMoney	0	500	350	450	450
exitCan	0	0	0	0	0
exitCup	0	0	Cup_1	0	0
menuButton[1]	0	1	0	0	0
menuButton[6]	0	0	0	1	0
state	initial	activat	activat	activat	activat

## 03 Property – test2

- **test2** : SPEC AG(**totalMoney = 450 & menuButton[6]** & ~refundButton & actMoney = 0 & ~(**menuButton[1] | menuButton[2] | menuButton[3] | menuButton[4] | menuButton[5] | menuButton[7] | menuButton[8] | menuButton[9] | menuButton[10]**)  
-> **AX(disMoney = 450 & exitCan = 0)**);

### State

- disMoney = 450

### Transition label

- menuButton[6] ( 500원짜리 캔음료 )



### State

- disMoney = 450
- exitCan = 0

The screenshot shows a model checker interface with a 'Results' tab selected. A table displays the results for the property 'test2', which is marked as 'true'. Below the table, a 'File' pane shows the model checking results, including the number of states reached (1758), iterations (29), and various timing metrics. The results confirm that the property 'test2' is satisfied.

Property	Result	Time
test2	true	Thu Apr 30 22:19:13 KST 2015

```
File
reached states BDD size.....1758
iteration 29.....87
user time.....23.2753 s
system time.....0.109201 s
Model checking time: 23.103748
user time.....23.2753 s
system time.....0.109201 s

Model checking results
=====
test2.....true
See file "Vending.warn" for warnings.

user time.....23.2753 s
system time.....0.109201 s

Resources used
=====
user time.....23.2753 s
system time.....0.109201 s
BDD nodes allocated.....756084
data segment size.....0

Property: test2      i-search:
```

## 03 Property – test2

- **test2** : SPEC AG(**totalMoney = 450 & menuButton[6]** & ~refundButton & actMoney = 0 & ~(menuButton[1] | menuButton[2] | menuButton[3] | menuButton[4] | menuButton[5] | menuButton[7] | menuButton[8] | menuButton[9] | menuButton[10])  
-> **AX(disMoney = 450 & exitCan = Can\_1)**);

### State

- disMoney = 450

### Transition label

- menuButton[6] ( 500원짜리 캔음료 )



### State

- disMoney = 450
- exitCan = 0 ( **Can\_1** )

Property	Result	Time
test2	false	Thu Apr 30 22:37:12 KST 2015

File	Edit	Run	View
actMoney	i_500	0	i_100 0 0
disMoney	0	500	350 450 450
exitCan	0	0	0 0
exitCup	0	0	Cup_1 0 0
menuButton[1]	0	1	0 0 0
menuButton[6]	0	0	0 1 0
state	initial	activat	activat activat activat

## 03 Property – test3

- **test3** : SPEC AG(**totalMoney = 700 & menuButton[1] & menuButton[7]** & ~refundButton & actMoney = 0 & ~(menuButton[2] | menuButton[3] | menuButton[4] | menuButton[5] | menuButton[6] | menuButton[8] | menuButton[9] | menuButton[10])  
-> **AX(disMoney = 700 & exitCan = 0 & exitCup = 0)**);

### State

- disMoney = 700

### Transition label

- menuButton[1] ( 150원짜리 컵 음료 )
- menuButton[7] ( 700원짜리 캔 음료 )



### State

- disMoney = 700
- exitCan = 0
- exitCup = 0

Property	Result	Time
test3	true	Thu Apr 30 23:02:33 8월 21일 2015

```
File
reached states BDD size.....160750
iteration 29.....348
user time.....405.062 s
system time.....0.76409 s
Model checking time: 404.999420
user time.....405.14 s
system time.....0.873606 s

Model checking results
=====
test3.....true
See file "Vending.warn" for warnings.

user time.....405.14 s
system time.....0.873606 s

Resources used
=====
user time.....405.14 s
system time.....0.873606 s
BDD nodes allocated.....21667515
data segment size.....0

Property: test3
```



## 03 Property – test4

- **test4** : SPEC AG(**totalMoney = 500 & cupStock[1] = 0 & menuButton[4]** & ~refundButton & actMoney = 0 & ~(menuButton[1] | menuButton[2] | menuButton[3] | menuButton[5] | menuButton[6] | menuButton[7] | menuButton[8] | menuButton[9] | menuButton[10])  
-> **AX(disMoney = 500 & exitCup = 0)**);

### State

- disMoney = 500
- cupStock[1] = 0

### Transition label

- menuButton[4] ( 250원짜리 컵 음료 )



### State

- disMoney = 500
- exitCup = 0

Property	Result	Time
test4	true	Fri May 01 11:03:03 2015

```
reached states BDD size.....7339
iteration 29.....306
user time.....43.7323 s
system time.....0.405603 s
Model checking time: 43.669903
user time.....43.7791 s
system time.....0.421203 s

Model checking results
=====
test4.....true

See file "Vending.warn" for warnings.

user time.....43.7791 s
system time.....0.421203 s

Resources used
=====
user time.....43.7791 s
system time.....0.421203 s
BDD nodes allocated.....10381996
data segment size.....0
```



## 03 Property – test4

- **test4** : SPEC AG(**totalMoney = 500 & cupStock[1] = 0 & menuButton[4]** & ~refundButton & actMoney = 0 & ~(menuButton[1] | menuButton[2] | menuButton[3] | menuButton[5] | menuButton[6] | menuButton[7] | menuButton[8] | menuButton[9] | menuButton[10])  
-> **AX(disMoney = 250 & exitCup = Cup\_4)**;

### State

- disMoney = 500
- cupStock[1] = 0

### Transition label

- menuButton[4] ( 250원짜리 컵 음료 )



### State

- disMoney = 500 ( **250** )
- exitCup = 0 ( **Cup\_4** )

Property	Result	Time
test4	false	Fri May 01 11:06:56 新羅酒店 1層以東 2015

	1	2	3	4	5				
actMoney	i_1000	0	0	0	0				
cupStock[1]	2	2	1	0	0				
disMoney	0	1000	750	500	500				
exitCup	0	0	Cup_4	Cup_4	0				
lampState[4]	off	on	on	err	err				
menuButton[4]	0	1	1	1	0				
state	initial	activate	activate	activate	activate				

Property: test4      i-search:

## 03 Property – test5

- **test5** : SPEC AG(**totalMoney = 0 & menuButton[9]** & ~refundButton & actMoney = 0 & ~(menuButton[1] | menuButton[2] | menuButton[3] | menuButton[4] | menuButton[5] | menuButton[6] | menuButton[7] | menuButton[8] | menuButton[10])  
-> **AX(disMoney = 0)**);

### State

- disMoney = 0

### Transition label

- menuButton[9] ( 1000원짜리 컵 음료 )



### State

- disMoney = 1000 ( 0 )

Property	Result	Time
test5	false	Fri May 01 11:24:39 8월 1일 2015

File	Edit	Run	View
	1	2	
actMoney	0	0	
disMoney	0	1000	
menuButton[9]	1	0	
state	initial	initial	

## 03 Property – test5

### - 문제사항

금액이 투입된 상태에서 모든 돈을 소진했을 시에 initial 상태로 바뀌지 않았음.

### - 해결방안

투입된 금액을 모두 소진했을 시 initial 상태로 변환

```
else if(menuButton[8])
{
if(totalMoney = 700) next(state) := initial;
next(totalMoney) := totalMoney - 700;
next(disMoney) := totalMoney - 700;
exitSystem();
}
else if(menuButton[9])
{
if(totalMoney = 1000) next(state) := initial;
next(totalMoney) := totalMoney - 1000;
next(disMoney) := totalMoney - 1000;
exitSystem();
}
else if(menuButton[10])
{
if(totalMoney = 1200) next(state) := initial;
next(totalMoney) := totalMoney - 1200;
next(disMoney) := totalMoney - 1200;
exitSystem();
}
```

## 03 Property – test5

- **test5** : SPEC AG(**totalMoney = 0 & menuButton[9]** & ~refundButton & actMoney = 0 & ~(menuButton[1] | menuButton[2] | menuButton[3] | menuButton[4] | menuButton[5] | menuButton[6] | menuButton[7] | menuButton[8] | menuButton[10])  
-> **AX(disMoney = 1000)**);

### State

- disMoney = 0

### Transition label

- menuButton[9] ( 1000원짜리 컵 음료 )



### State

- disMoney = 1000

The screenshot shows a software interface with a menu bar (File, Prop, View, Goto, History, Abstraction, Help) and a toolbar (Browser, Properties, Results, Cone, Using, Groups). The 'Results' tab is active, displaying a table with columns 'Property', 'Result', and 'Time'. The table contains one entry: 'test5' with 'true' as the result and 'Fri May 01 11:22:28 6월 1일 11:22:28 2015' as the time. Below the table, there are tabs for 'Source', 'Trace', and 'Log'. The 'Log' tab is selected, showing a detailed output of the model checker's execution, including statistics on states, iterations, and model checking results. The output confirms that the property 'test5' is true.

```
File Prop View Goto History Abstraction Help
Browser Properties Results Cone Using Groups
All results
Property Result Time
test5 true Fri May 01 11:22:28 6월 1일 11:22:28 2015

Source Trace Log
File
reached states BDD size.....1114
iteration 29.....67
user time.....237.184 s
system time.....0.0936006 s
Model checking time: 237.027919
user time.....237.184 s
system time.....0.124801 s

Model checking results
=====
test5.....true
See file "Vending.warn" for warnings.

user time.....237.184 s
system time.....0.124801 s

Resources used
=====
user time.....237.184 s
system time.....0.124801 s
BDD nodes allocated.....3315546
data segment size.....0

Property: test5 i-search:
```

## 03 Property – test5

- **test5** : SPEC AG(**totalMoney = 0 & menuButton[9]** & ~refundButton & actMoney = 0 & ~(menuButton[1] | menuButton[2] | menuButton[3] | menuButton[4] | menuButton[5] | menuButton[6] | menuButton[7] | menuButton[8] | menuButton[10])  
-> **AX(disMoney = 0)**);

### State

- disMoney = 0

### Transition label

- menuButton[9] ( 1000원짜리 컵 음료 )



### State

- disMoney = 0 ( **1000** )

Property	Result	Time
test5	false	Fri May 01 11:38:25 a/쿠팡월일 / 05/01/2015

	1	2	3	4					
actMoney	i_1000	0	0	0					
disMoney	0	1000	0	0					
menuButton[9]	0	1	1	0					
state	initial	activate	activate	activate					

## 03 Property – test6

- **test6** : SPEC AG(**totalMoney = 1200 & canStock[5] = 2 & menuButton[10]** & ~refundButton & actMoney = 0 & ~(menuButton[1] | menuButton[2] | menuButton[3] | menuButton[4] | menuButton[5] | menuButton[6] | menuButton[7] | menuButton[8] | menuButton[9])  
-> **AX(disMoney = 0 & exitCan = Can\_5 & state = initial)**);

### State

- disMoney = 1200
- canStock[5] = 2

### Transition label

- menuButton[10] ( 1200원짜리 컵 음료 )



### State

- disMoney = 0
- exitCan = Can\_5
- state = initial

Property	Result	Time
test6	true	Fri May 01 12:23:47 6월 2일 10:00 2015

```
File
reached states BDD size.....11340
iteration 29.....77
user time.....4.33167 s
system time.....0.312002 s
Model checking time: 4.206874
user time.....4.34727 s
system time.....0.327602 s

Model checking results
=====
test6.....true
See file "Vending.warn" for warnings.

user time.....4.34727 s
system time.....0.327602 s

Resources used
user time.....4.34727 s
system time.....0.327602 s
BDD nodes allocated.....6302621
data segment size.....0
```

## 03 Property – test6

- **test6** : SPEC AG(**totalMoney = 1200 & canStock[5] = 2 & menuButton[10]** & ~refundButton & actMoney = 0 & ~(menuButton[1] | menuButton[2] | menuButton[3] | menuButton[4] | menuButton[5] | menuButton[6] | menuButton[7] | menuButton[8] | menuButton[9])  
-> **AX(disMoney = 1200 & exitCan = Can\_5 & state = initial)**);

### State

- disMoney = 1200
- canStock[5] = 2

### Transition label

- menuButton[10] ( 1200원짜리 컵 음료 )



### State

- disMoney = 0 ( **1200** )
- exitCan = Can\_5
- state = initial

The screenshot shows a software tool interface with a menu bar (File, Prop, View, Goto, History, Abstraction, Help) and a toolbar (Browser, Properties, Results, Cone, Using, Groups). The 'Results' tab is active, displaying a table with columns 'Property', 'Result', and 'Time'. The table contains one entry: 'test6' with a result of 'false' and a time of 'Fri May 01 12:25:51 2015'. Below this, there are tabs for 'Source', 'Trace', and 'Log'. The 'Trace' tab is active, showing a table with columns 'File', 'Edit', 'Run', and 'View'. The table contains several rows of data, including 'actMoney', 'canStock[5]', 'disMoney', 'exitCan', 'lampState[10]', and 'menuButton[10]'. The 'state' row shows 'initial', 'activate', 'activate', 'activate', 'initial'.

Property	Result	Time
test6	false	Fri May 01 12:25:51 2015

File	Edit	Run	View		
1	2	3	4	5	
actMoney	i_100	i_100	i_1000	0	0
canStock[5]	2	2	2	2	1
disMoney	0	100	200	1200	0
exitCan	0	0	0	0	Can_5
lampState[10]	off	off	off	on	off
menuButton[10]	0	0	0	1	0
state	initial	activate	activate	activate	initial

## 03 Property – test7

- **test7** : SPEC AG(**totalMoney = 4050 & actMoney = i\_1000** & ~refundButton & ~(menuButton[1] | menuButton[2] | menuButton[3] | menuButton[4] | menuButton[5] | menuButton[6] | menuButton[7] | menuButton[8] | menuButton[9] | menuButton[10])  
-> **AX(disMoney = 4050 & o\_1000 = 1)**);

### State

- disMoney = 4050

### Transition label

- actMoney = i\_1000



### State

- disMoney = 4050
- o\_1000 = 1

The screenshot shows a model checker interface with a menu bar (File, Prop, View, Goto, History, Abstraction, Help) and a toolbar (Browser, Properties, Results, Cone, Using, Groups). The main window displays the results of a property test for 'test7'. The results table shows that the property was satisfied (true) on May 01, 2015. Below the table, the 'Source' tab is active, showing a log of the model checking process. The log includes details about the BDD size, iteration count, user and system times, and the final result of the model checking.

Property	Result	Time
test7	true	Fri May 01 12:59:57 韩国标准时间 2015

```
File
reached states BDD size.....1918
iteration 36.....47
user time.....38.4698 s
system time.....0.0312002 s
Model checking time: 38.329446
user time.....38.4698 s
system time.....0.0468003 s

Model checking results
=====
test7.....true
See file "Vending.warn" for warnings.

user time.....38.4698 s
system time.....0.0468003 s

Resources used
=====
user time.....38.4698 s
system time.....0.0468003 s
BDD nodes allocated.....1457530
data segment size.....0

Property: test7
```





## 03 Property – test8

- test8** : SPEC AG(**totalMoney = 500 & cupStock[1] = 1 & menuButton[5]** & ~refundButton & actMoney = 0 & ~(menuButton[1] | menuButton[2] | menuButton[3] | menuButton[4] | menuButton[6] | menuButton[7] | menuButton[8] | menuButton[9] | menuButton[10])  
-> **AX(disMoney = 200 & exitCup = Cup\_5 & lampState[1] = err & lampState[2] = err & lampState[3] = err & lampState[4] = err & lampState[5] = err)**);

### State

- disMoney = 500
- cupStock[1] = 1

### Transition label

- menuButton[5]



### State

- disMoney = 200
- exitCup = Cup\_5
- lampState[1] ~ [5] = err

The screenshot shows a model checker interface with a menu bar (File, Prop, View, Goto, History, Abstraction, Help) and a toolbar (Browser, Properties, Results, Cone, Using, Groups). The main window displays a table of results for the property 'test8'.

Property	Result	Time
test8	true	Fri May 01 14:06:46 韩国标准时间 2015

Below the table, there are tabs for Source, Trace, and Log. The Log tab is active, showing the following text:

```
File
A model checking problem isomorphic to this one has been solved in the past.
Model checking will be skipped.
To prevent this, use -force, or remove .smv_history.
user time.....0.171601 s
system time.....0 s

Model checking results
=====
test8.....true

See file "Vending.warn" for warnings.

user time.....0.171601 s
system time.....0 s

Resources used
=====
user time.....0.171601 s
system time.....0 s
BDD nodes allocated.....0
data segment size.....0
```

At the bottom, the status bar shows 'Property: test8' and 'i-search:'.

## 03 Property – test8

- **test8** : SPEC AG(**totalMoney = 500 & cupStock[1] = 1 & menuButton[5]** & ~refundButton & actMoney = 0 & ~(menuButton[1] | menuButton[2] | menuButton[3] | menuButton[4] | menuButton[6] | menuButton[7] | menuButton[8] | menuButton[9] | menuButton[10])  
-> **AX(disMoney = 200 & exitCup = Cup\_5 & lampState[1] = on & lampState[2] = on & lampState[3] = off & lampState[4] = off & lampState[5] = off)**);

### State

- disMoney = 500
- cupStock[1] = 1

### Transition label

- menuButton[5]



### State

- disMoney = 200
- exitCup = Cup\_5
- lampState[1] ~ [2] = err ( on )
- lampState[3] ~ [5] = err ( off )

Property	Result	Time
test8	false	Fri May 01 14:02:36 2015

File	Edit	Run	View
actMoney	i_500	0	i_100 i_100 0 0
cupStock[1]	2	2	1 1 1 0
disMoney	0	500	300 400 500 200
exitCup	0	0	Cup_2 0 0 Cup_5
lampState[1]	off	on	on on on err
lampState[2]	off	on	on on on err
lampState[3]	off	on	on on on err
lampState[4]	off	on	on on on err
lampState[5]	off	on	on on on err
menuButton[2]	0	1	0 0 0 0
menuButton[5]	0	0	0 0 1 0
state	initial	activate	activate activate activate activate

## 03 Property – test9

- **test9** : SPEC AG(**totalMoney = 150 & lampState[1] = err & menuButton[1]** & ~refundButton & actMoney = 0 & ~(menuButton[2] | menuButton[3] | menuButton[4] | menuButton[5] | menuButton[6] | menuButton[7] | menuButton[8] | menuButton[9] | menuButton[10])-  
> **AX(disMoney = 150 & exitCup = 0)**);

### State

- disMoney = 150
- lampState[1] = err

### Transition label

- menuButton[1]



### State

- disMoney = 150
- exitCup = 0

The screenshot shows a model checker interface with a menu bar (File, Prop, View, Goto, History, Abstraction, Help) and a toolbar (Browser, Properties, Results, Cone, Using, Groups). The main window displays the results of a property test for 'test9'. The results table shows that the property was satisfied (Result: true) and the test was completed on Friday, May 01, 2015, at 14:13:40. The interface also shows a 'Source' tab with a 'Log' view, displaying the following output:

```
File
reached states BDD size.....2139
iteration 29.....206
user time.....21.1225 s
system time.....0.124801 s
Model checking time: 20.997735
user time.....21.1225 s
system time.....0.140401 s

Model checking results
=====
test9.....true
See file "Vending.warn" for warnings.

user time.....21.1225 s
system time.....0.140401 s

Resources used
=====
user time.....21.1225 s
system time.....0.140401 s
BDD nodes allocated.....1437737
data segment size.....0
```

The bottom of the window shows the property being tested: 'Property: test9' and a search field with 'i-search:'.

## 03 Property – test9

- **test9** : SPEC AG(**totalMoney = 150 & lampState[1] = err & menuButton[1]** & ~refundButton & actMoney = 0 & ~(menuButton[2] | menuButton[3] | menuButton[4] | menuButton[5] | menuButton[6] | menuButton[7] | menuButton[8] | menuButton[9] | menuButton[10])-  
> **AX(disMoney = 0 & exitCup = 0)**);

### State

- disMoney = 150
- lampState[1] = err

### Transition label

- menuButton[1]



### State

- disMoney = 150 ( 0 )
- exitCup = 0

File Prop View Goto History Abstraction Help

Browser Properties Results Cone Using Groups

All results

Property	Result	Time
test9	false	Fri May 01 14:17:52 星期五 2015

Source Trace Log

File Edit Run View

	1	2	3	4	5				
actMoney	i_500	0	0	0	0				
disMoney	0	500	350	150	150				
exitCup	0	0	Cup_1	Cup_2	0				
lampState[1]	off	on	on	err	err				
menuButton[1]	0	1	0	1	0				
menuButton[2]	0	0	1	0	0				
state	initial	activate	activate	activate	activate				

Property: test9

i-search: