Session 10

Black Box Testing (4)

Cause Effect Graph

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Black Box Testing Techniques

- Boundary Value Analysis
- Equivalence Partitioning
- Decision Table
- Cause-Effect Graph
- Combinatorial Test

Cause-Effect Graph

Cause-effect graph models the logical relationship between program input and output which can be expressed as a Boolean expression.

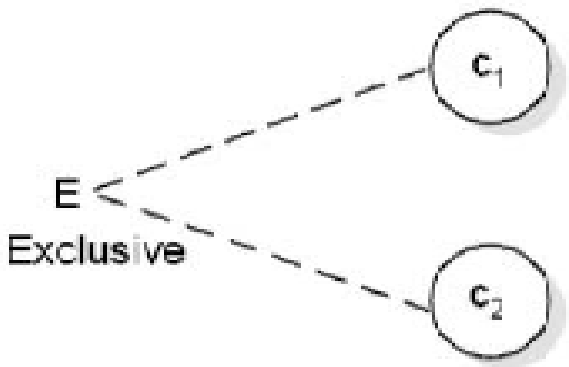
Cause:any condition in the requirements that may effect the program output
(e.g. side>0,side1!=side2,month=feb)

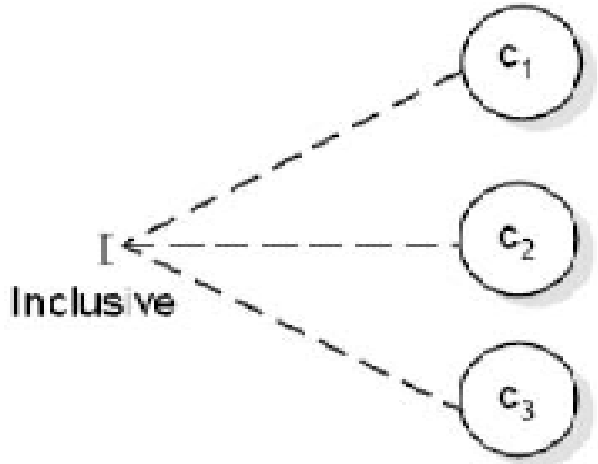
Effect:response of a program to some combinations of input conditions
(e.g.error message displayed on the screen,
a new window is displayed,or
database is updated)

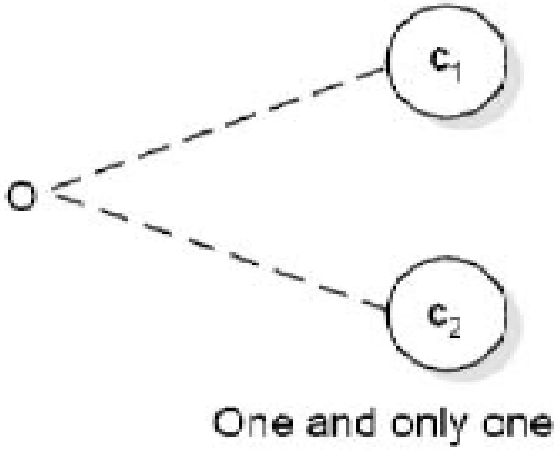
Procedure

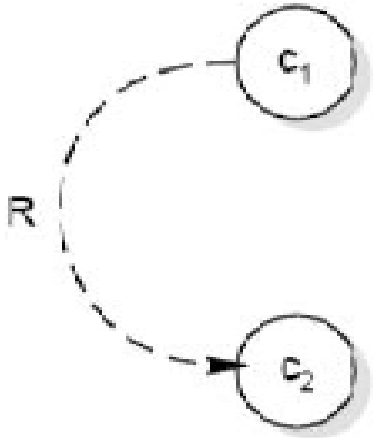
1. Identify causes and effects in specification
2. Make Boolean graph linking causes and effects.
3. Annotate impossible combinations of causes and effects (adding constraints)
4. Develop decision table from graph
5. Transform each column into test case

3. Annotate impossible combinations of causes and effects (adding constraints)









Symbol for masks constraint

Example1

Passenger may get a discount ticket if he/she is below 12 or a student below 25.

Example1

Passenger may get a discount ticket if

he/she is below 12 or a student below 25.

C1: Age < 12

C2: Age < 25

C3: Status = Student

I1: He/she is a student below 25

E1: Passenger can get a discount ticket

Example2

- The character in column 1 must be an ‘A’ or ‘B’. The character in column 2 must be a digit. In this situation, the file update is made. If the character in column 1 is incorrect, message x is issued. If the character in column 2 is not a digit, message y is issued.

The causes are

c_1: character in column 1 is A

c_2: character in column 1 is B

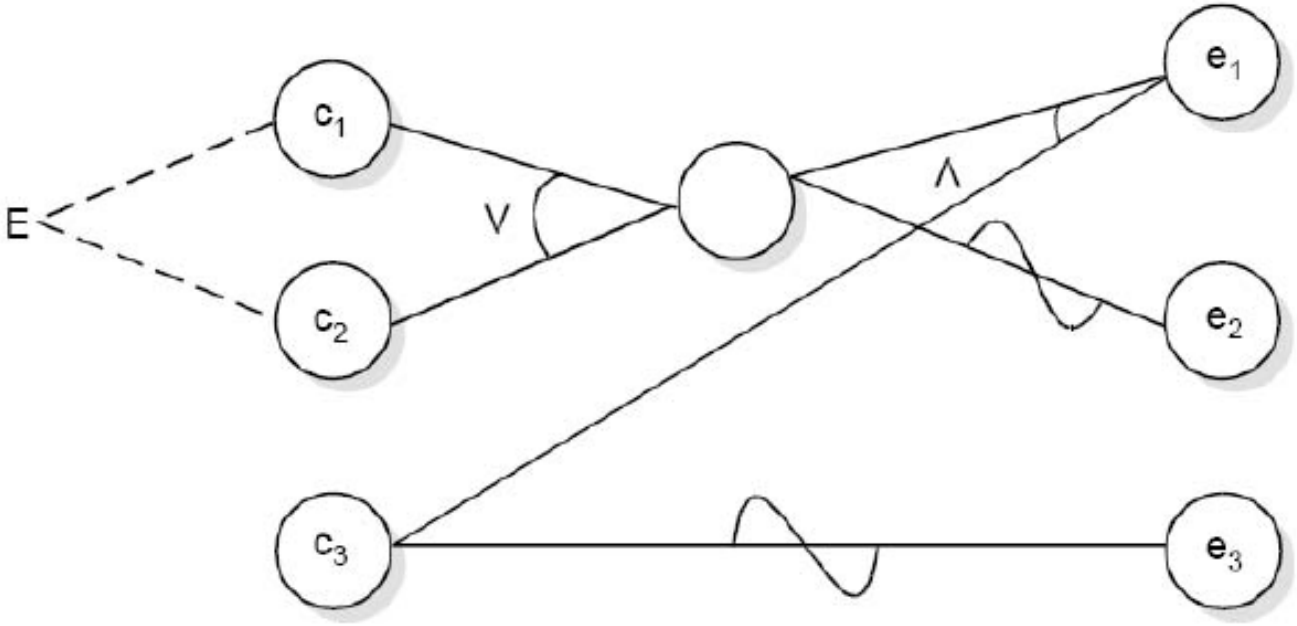
c_3: character in column 2 is a digit

and the effects are

e_1: update made

e_2: message *x* is issued

e_3: message *y* is issued



		1	2	3	4	5	6	7	8
条件（原因）	1	1	1	1	1	0	0	0	0
	2	1	1	0	0	1	1	0	0
	3	1	0	1	0	1	0	1	0
	11			1	1	1	1	0	0
动作（结果）	22			0	0	0	0	1	1
	21			1	0	1	0	0	0
	23			0	1	0	1	0	1
测试用例				A3	AM	B5	BN	C2	DY
				A8	A?	B4	B!	X6	P;

- **Causes (input conditions)**
  - 1. Sex is Male
  - 2. Sex is Female
  - 3. Age is <25
  - 4. Age is >=25 and < 65
  - 5. Age is >= 65

- **Effects (output conditions)**
  - 100. Premium is $1000
  - 101. Premium is $3000
  - 102. Premium is $1500
  - 103. Premium is $500

Test Case	1	2	3	4	5	6
Causes:						
1 (male)	1	1	1	0	0	0
2 (female)	0	0	0	1	1	1
3 (<25)	1	0	0	0	1	0
4 (>=25 and < 65)	0	1	0	0	0	1
5 (>= 65)	0	0	1	1	0	0
Effects:						
100 (Premium is $1000)	0	1	0	0	0	0
101 (Premium is $3000)	1	0	0	0	0	0
102 (Premium is $1500)	0	0	1	1	0	0
103 (Premium is $500)	0	0	0	0	1	1

Test Case #	Inputs (Causes)		Expected Output (Effects)
	Sex	Age	Premium
1	Male	<25	$3000
2	Male	>=25 and < 65	$1000
3	Male	>= 65	$1500
4	Female	>= 65	$1500
5	Female	<25	$500
6	Female	>=25 and < 65	$500

Example 4

有一个处理单价为5角钱的饮料的自动售货机软件测试用例的设计。其规格说明如下：

- 若投入5角钱或1元钱的硬币，押下〖橙汁〗或〖啤酒〗的按钮，则相应的饮料就送出来。
- 若售货机没有零钱找，则一个显示〖零钱找完〗的红灯亮，这时在投入1元硬币并押下按钮后，饮料不送出来而且1元硬币也退出来；
- 若有零钱找，则显示〖零钱找完〗的红灯灭，在送出饮料的同时退还5角硬币。

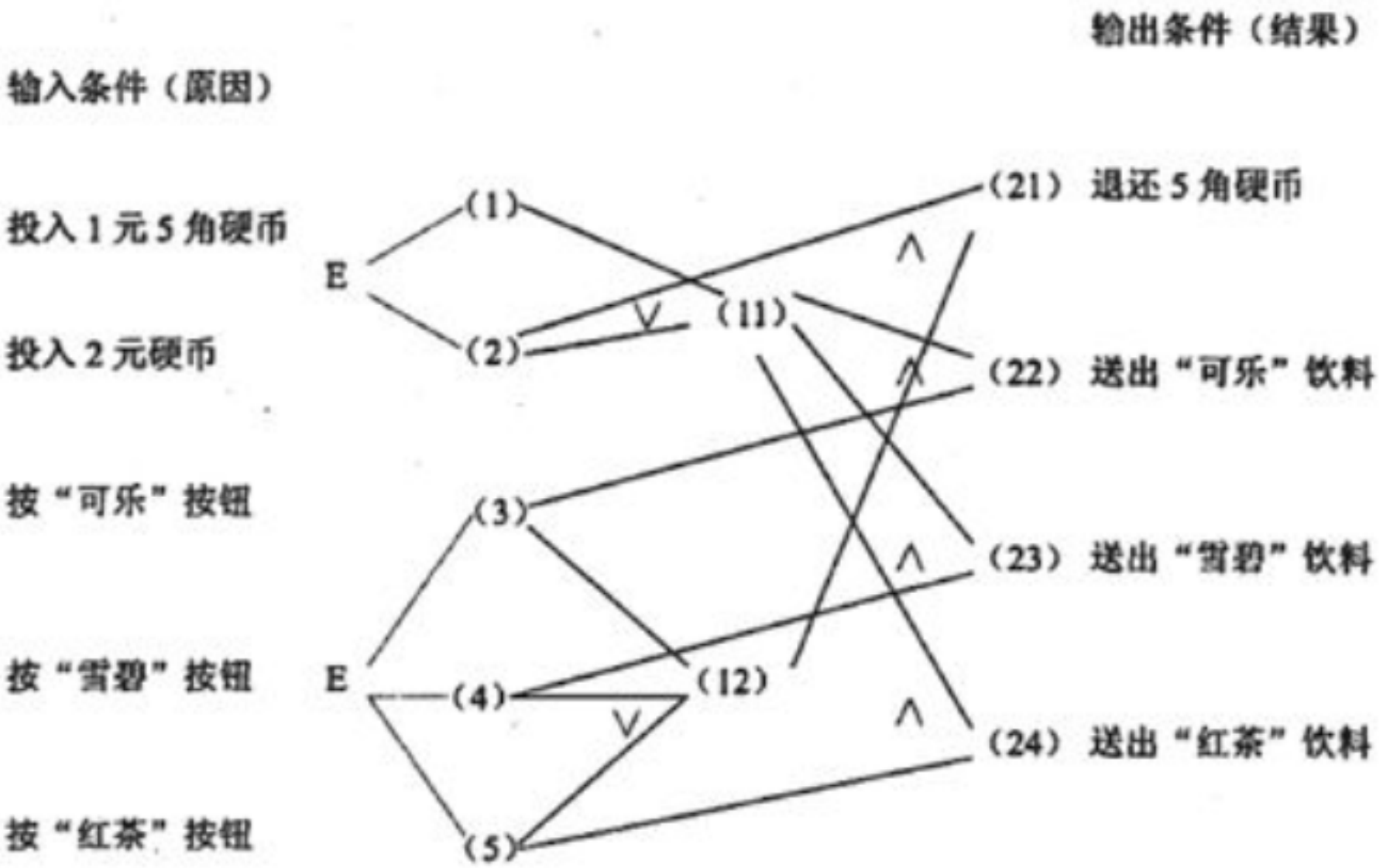
- 画出因果图，如图所示。所有原因结点列在左边，所有结果结点列在右边。建立中间结点，表示处理的中间状态。中间结点：
  - 11. 投入1元硬币且押下饮料按钮 该找5角
  - 12. 押下〖橙汁〗或〖啤酒〗的按钮 押下按钮
  - 13. 应当找5角零钱并且售货机有零钱找 可找5角
  - 14. 钱已付清 钱付清

- 3)转换成判定表：

序号		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1	2
条件	①	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	②	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	③	1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0
	④	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0
	⑤	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
中间结果	⑪						1	1	0		0	0	0		0	0	0						1	1	0		0	0	0		0	0	0
	⑫						1	1	0		1	1	0		1	1	0						1	1	0		1	1	0		1	1	0
	⑬						1	1	0		0	0	0		0	0	0						0	0	0		0	0	0		0	0	0
	⑭						1	1	0		1	1	1		0	0	0						0	0	0		1	1	1		0	0	0
结果	㉑						0	0	0		0	0	0		0	0	0						1	1	1		1	1	1		1	1	1
	㉒						0	0	0		0	0	0		0	0	0						1	1	0		0	0	0		0	0	0
	㉓						1	1	0		0	0	0		0	0	0						0	0	0		0	0	0		0	0	0
	㉔						1	0	0		1	0	0		0	0	0						0	0	0		1	0	0		0	0	0
	㉕						0	1	0		0	1	0		0	0	0						0	0	0		0	1	0		0	0	0
测试用例							Y	Y	Y		Y	Y	Y		Y	Y							Y	Y	Y		Y	Y	Y		Y	Y	

Exercise-2

- Other version of vending machine.
  - 有一个处理单价为1元5角钱的盒装饮料的自动售货机。若投入1元5角硬币，按下“可乐”、“雪碧”或“红茶”按钮，相应的饮料就送出来。若投入的是2元硬币，在送出饮料的同时退还5角硬币。


输出条件（结果）
输入条件（原因）
投入1元5角硬币
投入2元硬币
按“可乐”按钮
按“雪碧”按钮
按“红茶”按钮
E
E
(1)
(2)
(3)
(4)
(5)
(11)
(12)
(21) 退还5角硬币
(22) 送出“可乐”饮料
(23) 送出“雪碧”饮料
(24) 送出“红茶”饮料

Exercise-3

- Given the requirements as follows:
  - For international airlines of Europe and America, all classes have in-flight meals and in-flight entertainments;
  - For other international airlines, all classes have in-flight meals, only business classes have in-flight entertainments;
  - For domestic airlines, business classes have in-flight meals, but no in-flight entertainments;
  - For domestic airlines, economy classes have in-flight meals if the flying time is longer than 2 hours, but no in-flight entertainments.
- Design the corresponding **extended** **entry decision table:**