Boolovská diferencia

Zmena na vstupe x_i sa prejaví na výstupe f práve vtedy, ak Boolovská diferencia

$$\frac{df(X)}{dx_i} = f(x_1,\ldots, x_{i-1}, 0, x_{i+1},\ldots, x_n) \oplus f(x_1,\ldots, x_{i-1}, 1, x_{i+1},\ldots, x_n) = 1$$

Určovanie B-diferencie:

a) v K-mapách degenerovaného tvaru

f = ab + ac + bd + cd

					b	b	b	b
			c	c	c	c		
		d	d			d	d	
	0	0	1	0	0	1	1	0
a	0	0	1	1	1	1	1	1

$\frac{df}{da}$:   0 0 0 1 1 0 0 1

$$\frac{df}{da} = c\overline{d} + b\overline{d}$$

b) použitím pravidiel pre určovanie B-diferencie

$$\frac{d\overline{f}(X)}{dx_i} = \frac{df(X)}{dx_i}$$

$$\frac{df(X)}{d\overline{x}_i} = \frac{df(X)}{dx_i}$$

$$\frac{d\left[f(X)+g(X)\right]}{dx_i} = \overline{f}(X)\cdot\frac{dg(X)}{dx_i} \oplus \overline{g}(X)\cdot\frac{df(X)}{dx_i} \oplus \frac{df(X)}{dx_i}\cdot\frac{dg(X)}{dx_i}$$

$$\frac{d\left[f(X)\cdot g(X)\right]}{dx_i} = f(X)\cdot\frac{dg(X)}{dx_i} \oplus g(X)\cdot\frac{df(X)}{dx_i} \oplus \frac{df(X)}{dx_i}\cdot\frac{dg(X)}{dx_i}$$

$$\frac{d\left[f(X)\oplus g(X)\right]}{dx_i} = \frac{df(X)}{dx_i} \oplus \frac{dg(X)}{dx_i}$$

$$\frac{d\left[k + f(X)\right]}{dx_i} = \overline{k}\cdot\frac{df(X)}{dx_i}$$

$$\frac{d\left[k\cdot f(X)\right]}{dx_i} = k\cdot\frac{df(X)}{dx_i}$$

$$\frac{d[k + k_1 .x_i]}{dx_i} = \overline{k}.\, k_1$$

$$\frac{d\left[k + k_0\overline{x}_i + k_1x_i\right]}{dx_i} = \overline{k}\cdot(k_0 \oplus k_1)$$

Ak $f(X) = f[X_1, g(X_2)]$, pričom $x_i \notin X_1$ potom

$$\frac{df(X)}{dx_i} = \frac{df(X)}{dg(X_2)} \cdot \frac{dg(X_2)}{dx_i}$$

Boolovské diferencie vyšších rádov – zodpovedajú výskytu viacnásobných porúch

$$\frac{d^2 f(X)}{dx_{i1} dx_j} = f(x_1, \ldots, x_i, \ldots, x_j, \ldots, x_n) \oplus f(x_1, \ldots, \overline{x}_i, \ldots, \overline{x}_j, \ldots, x_n)$$

Podmienky testovania jednotlivých aj viacnásobných porúch na vstupoch x_i a x_j

$$\frac{df(X)}{d(x_i + x_j)} = \frac{df(X)}{d(x_i \oplus x_j)} + \frac{df(X)}{d(x_i x_j)}$$

pričom

$$\frac{df(X)}{d(x_i \oplus x_j)} = \frac{df(X)}{dx_i} \oplus \frac{df(X)}{dx_j}$$

Porucha t0 na vstupe x_i bude detegovaná, ak platí

$$x_i \frac{df(X)}{dx_i} = 1$$

Porucha t1 na vstupe x_i bude detegovaná, ak platí

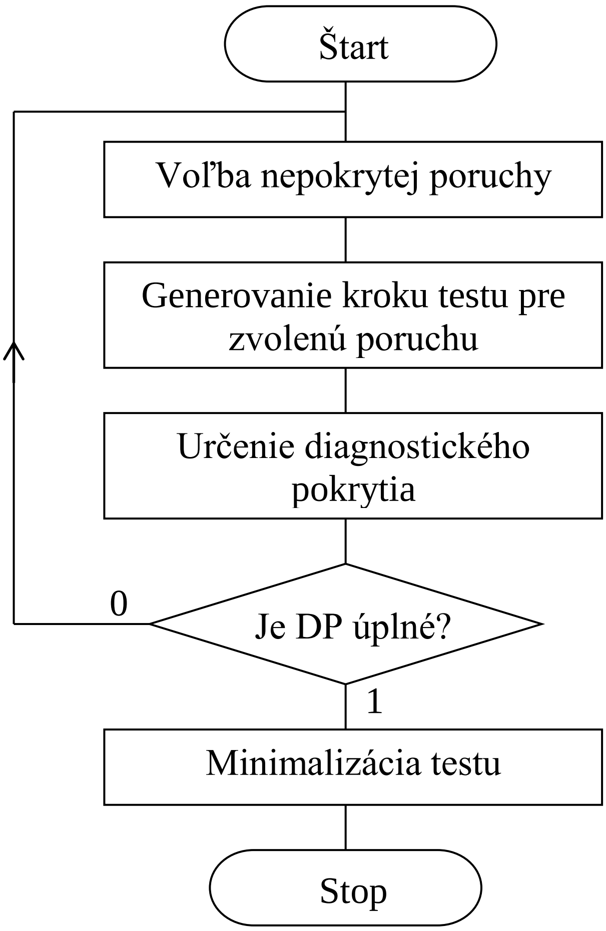
$$\overline{x}_i \frac{df(X)}{dx_i} = 1$$

Generovanie úplných testov

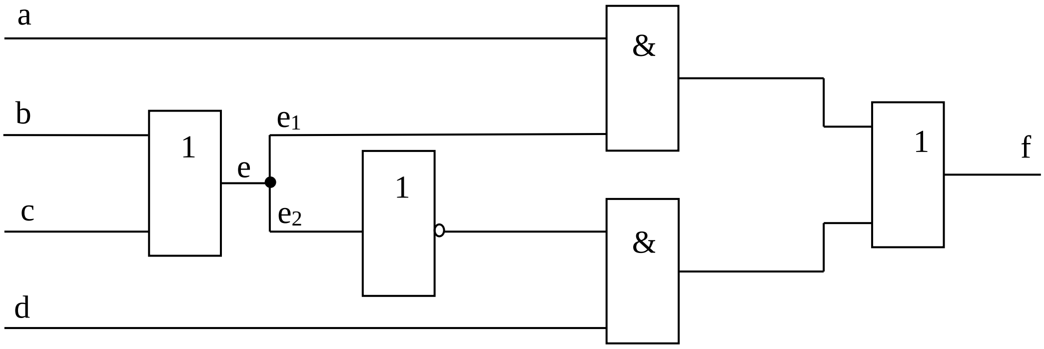
V1. Test KO bez rozvetvenia, zostaveného z elementárnych LČ, je úplný voči poruchám t0 a t1, ak deteguje všetky poruchy t0 a t1 na primárnych vstupoch obvodu.

V2. Test KO zostaveného z elementárnych LČ je úplný voči poruchám t0 a t1, ak deteguje všetky poruchy t0 a t1 na primárnych vstupoch a na všetkých vetvách vetviacich sa vodičov.

Vytváranie úplného testu



Príklad: $f = a(b + c) + [(b + c)|]d$



$$f = a\,b + a\,c + \bar{b}\,\bar{c}\,d$$

$$f = a\,e_1 + \bar{b}\,\bar{c}\,d \qquad e_1 = b + c$$

$$f = a\,b + a\,c + \bar{e}_2\,d \qquad e_2 = b + c$$

$$\frac{df}{da} = \overline{\bar{b}\bar{c}d}.(b + c) = (b + c + \bar{d}).(b + c) = b + c$$

$$\frac{df}{db} = \bar{a}\bar{c}d + a\bar{c}\bar{d}$$

$$\frac{df}{dc} = \bar{a}\bar{b}d + a\bar{b}\bar{d}$$

$$\frac{df}{dd} = \bar{b}.\bar{c}$$

$$\frac{df}{de_1} = ab + ac + a\bar{d}$$

$$\frac{df}{de_2} = \bar{a}d + \bar{b}\bar{c}d$$

a/0: $a\frac{df}{da} = a(b + c) = ab + ac = 1$

a/1: $\bar{a}\frac{df}{da} = \bar{a}(b + c) = \bar{a}b + \bar{a}c = 1$

b/0: $b\frac{df}{db} = b(\bar{a}\bar{c}d + a\bar{c}\bar{d}) = \bar{a}b\bar{c}d + ab\bar{c}\bar{d} = 1$

b/1: $\bar{b}\frac{df}{db} = \bar{b}(\bar{a}\bar{c}d + a\bar{c}\bar{d}) = \bar{a}\bar{b}\bar{c}d + a\bar{b}\bar{c}\bar{d} = 1$

c/0: $c\frac{df}{dc} = c(\bar{a}\bar{b}d + a\bar{b}\bar{d}) = \bar{a}\bar{b}cd + a\bar{b}c\bar{d} = 1$

c/1: $\bar{c}\frac{df}{dc} = \bar{c}(\bar{a}\bar{b}d + a\bar{b}\bar{d}) = \bar{a}\bar{b}\bar{c}d + a\bar{b}\bar{c}\bar{d} = 1$

d/0: $d\frac{df}{dd} = d.\bar{b}.\bar{c} = 1$

d/1: $\bar{d}\frac{df}{dd} = \bar{d}.\bar{b}.\bar{c} = 1$

e_1/0: $e_1.\frac{df}{de_1} = (b + c).(ab + ac + a\bar{d}) = ab + ac = 1$

e_1/1: $e_1.\frac{df}{de_1} = \overline{(b + c)}.(ab + ac + a\bar{d}) = a\bar{b}\bar{c}\bar{d} = 1$

e_2/0: $e_2.\frac{df}{de_2} = (b + c).(\bar{a}d + \bar{b}\bar{c}d) = \bar{a}bd + \bar{a}cd = 1$

e_2/1: $e_2.\frac{df}{de_2} = \overline{(b + c)}.(\bar{a}d + \bar{b}\bar{c}d) = a\bar{b}\bar{c}d + \bar{b}\bar{c}d = \bar{b}\bar{c}d = 1$

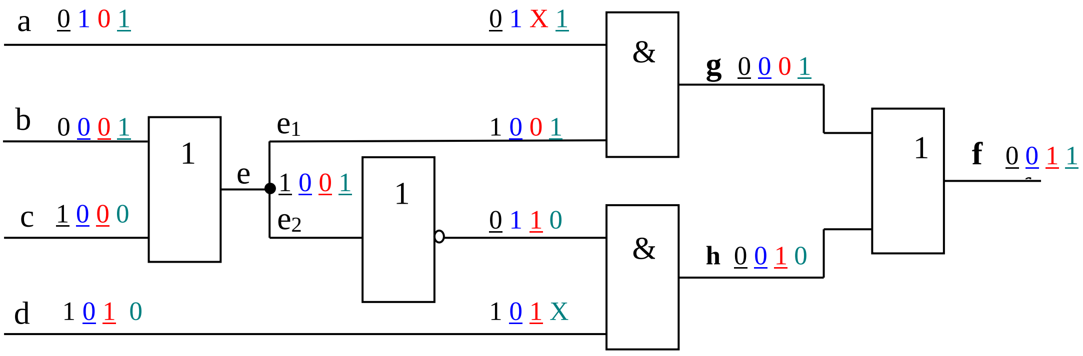
Kroky testu:

k	a	b	c	d	f	DP
1	1	1	X	X	1	a/0
2	1	X	1	X	1	a/0
3	0	1	X	X	0	a/1
4	0	X	1	X	0	a/1
5	0	1	0	1	0	b/0
6	1	1	0	0	1	b/0
7	0	0	0	1	1	b/1
8	1	0	0	0	1	b/1
9	0	0	1	1	0	c/0
10	1	0	1	0	0	c/0
11	0	0	0	1	1	c/1
12	1	0	0	0	0	c/1
13	X	0	0	1	1	d/0
14	X	0	0	0	0	d/1
15	1	1	X	X	1	e_1/0
16	1	X	1	X	1	e_1/0
17	1	0	0	0	0	e1/1
18	0	1	X	1	0	e2/0
19	0	X	1	1	0	e2/0
20	X	0	0	1	1	e_2/1

Úplný test:

k	a	b	c	d	f	DP
1	1	1	0	0	1	b/0, a/0, e_1/0
2	0	0	1	1	0	c/0, a/1, e2/0
3	1	0	0	0	0	e1/1,b/1,c/1, d/1
4	X	0	0	1	1	d/0, e_2/1

Metóda kritickej cesty



Hodnoty na vodiči **e** budú kritické, ak bude kritická hodnota buď na vodiči **e**$_1$ alebo na vodiči **e**$_2$. Pri kritických hodnotách na obidvoch vodičoch **e**$_1$ a **e**$_2$ hodnota na vodiči **e** pre vzájomné blokovanie rekonvergentných ciest kritickou nebude. Preto pri alternatívnych hodnotách na vodičoch **a** a **d** volíme hodnoty **0**, aby na vodiči **e** (teda aj na **b** a **c)** boli kritické hodnoty.