

Logic: Scoring Efficiency of Circuits

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Truth Table

Function

Binary (of inputs)

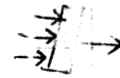
Subfunctions

Full function

Duplication of inputs

Intelligence { equivalence }
 { classes }

P	q	R	
1	1	1	1
0	1	1	0
1	0	1	0
0	0	1	1
1	1	0	1
0	1	0	0
1	0	0	0
0	0	0	0



if R is biased on get "if and only if." \equiv if off get "and"

6 ways of biasing 3 input fns.

If q is on get 1010 a 2 variable fn. reduced to 1 variable fn "reducing variable"

q is off get \neg "not if, then"

If p is on get 1010

p is off get \neg

sub-
got 3 full functions

Duplication can put same signal in in two places - take pairs + duplicate

take p+R some values 1000 some as "and" again

p+q " 1110 "inclusive or" one more sub. fn.

q+R " 1000 "and" again

Intelligence:

P	q	\neg	
1	1	1	1
0	1	1	0
1	0	0	1
0	0	1	1

"if, then" output 1101.

1011 is "intelligence equivalent" intelligence p+q.

Efficiency \equiv count subfunctions, but leave out intelligence classes.

Ref: "Multipurpose Bias ~~Device~~ Device" paper Dunham? part I.

Term: primed output nos.

(use these instead of using binary nos.)

- truth tables are in 4 bits, hence

1011'0110
5 1 3

Take 3 & skip, then put prime or no prime

write 5'3

What set of functions are best to build a machine from? What set is most efficient?

compare \boxplus \boxminus \boxtimes
3 types

no. of boxes needed to build circuits

evaluate:

First score - no duplication of inputs

Second score - with duplication of inputs.

can build expressions out of "neither-nos" only - very long eq.

using "and, or, not"

- get much shorter eq.

- mirror image (read most significant as least)

- denial (change all 0's to 1's & 1's to 0's) If a sub-fun has score of 4, the denial will also have 4

- cycle (class of three images & denials) mirror image also has same score - hard to prove, but

11010101 \rightarrow 10101011

no. of ways 2^{2^m} $m = \text{no of variable}$ 256 for 3 variables.

- scoring all 3 variable funs. only one has score of 6 all others are part of same cycle.

~~circle~~

Example
of 6 score

P	q	R	output
1	1	1	1
0	1	1	1
1	0	1	0
0	0	1	1
1	1	0	0
0	1	0	0
1	0	0	1
0	0	0	0

get $\supset \neq \neq \equiv$

duplicate inputs add
V •

for 4 variables: 65K sub-prog.

max score could be 14, (8 singles, 6 pairs)

There are actually 2 cycles which have 14 score

for 5 variables: — use search program "change bits" prog.

use one set, change one bit & rescore go up to dead end,

max. score = 40 out of a possible 68. although 1st scores of 36 are highest

2 or 4 cycles.

2nd scores 5 are up to 54.

for 6 variables:

68, 60 here found cases of these.

2nd scoring not yet done.

Many output case;



etc.

Example: full add.

80 cases { 45 require 3 units
35 " 2 or less units,

also the simpler ones seem to take less components too.