HW2 Prob 8 Again: *Even* More On Metaproducts

- What you know
  - That Rob should *never* have tried to put a metaproducts problem on this homework…
  - That middle-aged CAD faculty should *ask* their TAs before releasing their Powerpoint slides…
  - That there is *another* bug on another BDD in the "More on Metaproducts" previous version of this explanation
  - That you are really, *really* looking forward to getting on to HW3…
- What you don't know
  - How to fix this bug
  - If you're actually going to read this, or just go watch another rerun of "Friends" on channel 9…

Even More On Metaproducts

- Suppose I have a Boolean function of 2 vars: F(x,y)
  - If I want to consider writing an SOP equation for F(x,y), how many possible product terms could there be?
- Can enumerate: there are $3^2 = 9$ terms:
  - Every product has 2 "slots" for literals in it
  - The first slot can be one of {ε, x, x'} where "ε" means "empty"
  - The second slot can be one of {ε, y, y'} where "ε" also means "empty"
  - Why 9 terms max? |{ε, x, x'}| x |{ε, y, y'}| = 3x3 = 9
- Examples
  - Term xy' == (1st slot is x)(2nd slot is y')
  - Term x' == (1st slot is x')(2nd slot is ε -- empty)

Even More on Metaproducts

- Well, what are *all* 9 of these possible product terms?

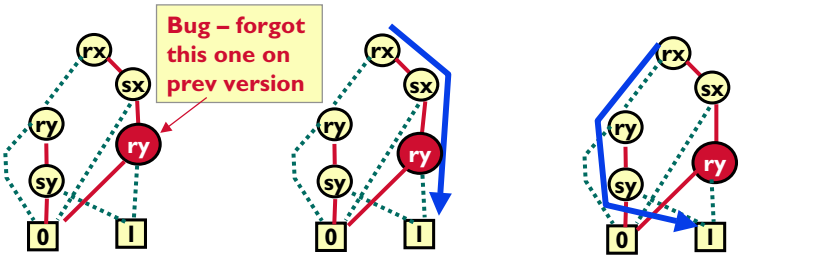
1st slot	2nd slot	Product Term Represented
ε	ε	ε = empty
x	ε	x
x'	ε	x'
ε	y	y
ε	y'	y'
x	y	xy
x	y'	xy'
x'	y	x'y
x'	y'	x'y'

- OK, what does this have to do with metaproducts…?

Even More on Metaproducts

- A metaproduct is really a BDD that represents *a set*
  - The set it represents is some arbitrary *set of product terms*, chosen from the complete set of 9 (in this 2-variable case) on previous slide

- Example: F(x,y) = x + y'



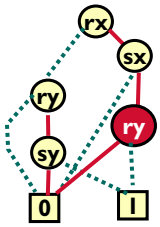
Metaproduct BDD

1st path to "1" node represents term " x "

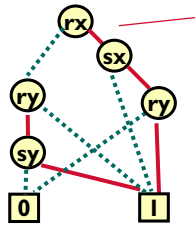
2nd path to "1" node represents term " y' "

Even More on Metaproducts

- So, what really happens when you complement this BDD?



Complement it



What is this?

```
(rx:240344
  (sx:240296
    (ry:240216)
    [1])
  (ry:240280
    (sy:240248)
    [1]))
```

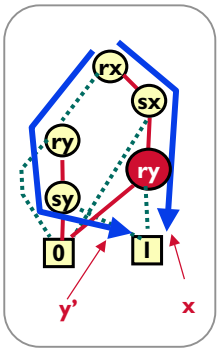
This one is actually OK: kbdd says this

It's the BDD for the set of all the OTHER product terms NOT in the original BDD…

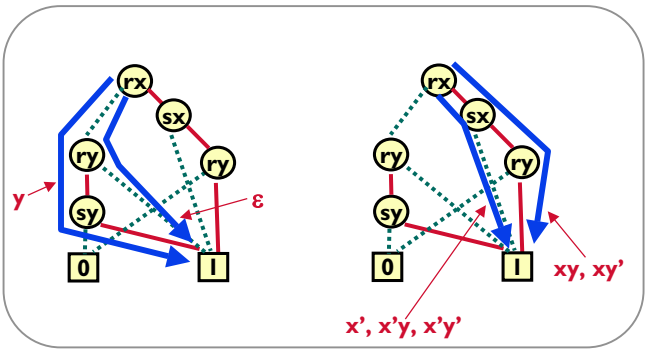
(Also, its just the *same* BDD as at left, with the 1 and the 0 flipped)

Even More on Metaproducts

- So, what really happens when you complement this BDD?
  - You get a new BDD that represents the 7 other products NOT in original set



2 product terms

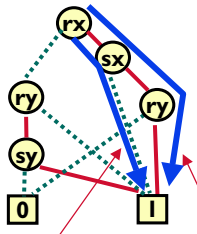


7 other product terms that were NOT in original set

Small bug – reversed labels on arrows in prev version

Even More on Metaproducts

- Subtle stuff
  - Interpreting what happens when you see missing variables

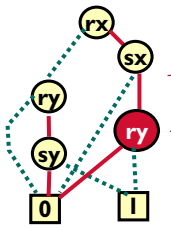


x is here and negative, but no y occurrence var. Interpret as: all values of y are possible, including the empty "ε" y value. Result is: x', x'y, x'y'

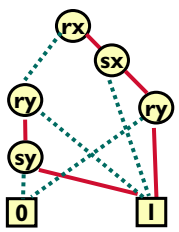
x is here and positive, y is here, but no y sign var. Interpret as: all "signed" values of y are possible, but not the empty "ε" y value. Result is: xy, xy'

Even More on Metaproducts

- So both original metaproduct BDD and its complement are just sets of stuff. They represent subsets of these 9 terms
  - When you complement one of these, you don't get F'( ). You get a set that represents all the other terms you didn't represent originally



1st slot	2nd slot	Product Term Represented
ε	ε	ε = empty
x	ε	x
x'	ε	x'
ε	y	y
ε	y'	y'
x	y	xy
x	y'	xy'
x'	y	x'y
x'	y'	x'y'



Represents these 2 of 9 possible terms

Represents these 7 of 9 possible terms

Back to Homework (Same as Previous Version)

- About HW2 Problem 8
  - The part about "..complement it and explain it" was aimed at this, but with F( ) = 4 variables, its just way too complicated to see. (Sorry…)
  - Do this instead of the complicated 4-variable function:
    - Let F(x,y) = x'y + xy'
    - Draw the BDD for the metaproduct form for F( )
    - Draw the complement BDD for this metaproduct BDD
    - Like in these notes, show that the complement really does represent all of the *other* product terms not in the original BDD.