Discrete Mathematics and its Applications

Ngày 12 tháng 9 năm 2011

Logic

(Introduction)

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4. *Truth tables.*

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5. *There are no positive integers* x, y, z *satisfying the equality* $x^5 + y^5 = z^5$
6. *There are infinitely many prime numbers q such that* $q = 4p + 1$ *where p is prime.*

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- *4 is a bit more intricate. Hoang cannot fix his own xe may since he fixes only those belonging to people that do not fix their own xe may but if he does not fix his own xe may then he is fixing it.*

Logic operation

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Almost all programming languages include boolean variables.

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Combining boolean variable is done with logic or boolean operators.

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There are other binary operators. Truth tables will help us understand how to construct them.

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Truth tables for the binary operators $\wedge$ $\vee$ $\rightarrow$:

p	q	$p \wedge q$		$p \vee q$		$p \rightarrow q$
T	T	T		T		T
F	T	F		T		T
T	F	F		T		F
F	F	F		F		T

Evaluating compound propositions with truth tables

Example

We wish to build the truth table for the compound proposition:
$(p \to q) \wedge (\neg p \to q)$

p	q	$p \to q$		$\neg p \to q$		$(p \to q) \wedge (\neg p \to q)$
T	T	T		T		T
F	T	T		T		T
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Operator	Precedence
$\neg$	1
$\land$	2
$\lor$	3
$\rightarrow$	4

Logic Computations Rules

Equivalence	Name
$p \vee F \equiv p; \quad p \wedge T \equiv p$	Identity
$p \vee T \equiv T; \quad p \wedge F \equiv F$	Domination
$p \vee p \equiv p; \quad p \wedge p \equiv p$	Idempotent
$p \vee q \equiv q \vee p; \quad p \wedge q \equiv q \wedge p$	commutative
$p \vee (q \vee r) \equiv (p \vee q) \vee r$ $p \wedge (q \wedge r) \equiv (p \wedge (q \wedge r)$	Associative
$p \vee (q \wedge r) \equiv (p \vee q) \wedge (p \vee r)$ $p \wedge (q \vee r) \equiv (p \wedge q) \vee (p \wedge r$	Distributive
$\neg(p \wedge q) \equiv \neg p \vee \neg q$ $\neg(p \vee q) \equiv \neg p \wedge \neg q$	De Morgan

Bảng: Basic computation laws

summary

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1. propositions

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6. we learned how to use truth tables to evaluate compound propositions
7. we conclude with two entertaining puzzles.

A simple puzzle

Trung, Hóa and Tuán had the same Pho for lunch at the same restaurant. They asked Hà to guess what they ate and where. To challenge Há they decided that each will tell Há two facts and at least one of the fcat will be true..

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$(a \vee b) \wedge (c \vee d) \wedge (\neg a \vee e) =$ **true** *which when expanded yields:*

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The only triple which is true is $(b \wedge c \wedge \neg a)$ *which says that they ate Pho gà at Pho-24.*

A classic logic puzzle

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Design a question that will guarantee to save the logician's life.