Solving Logic Problems
The Math of True and False
Kat's Cat Checker

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Variables

Variables are names for things that hold values, just like in coding. Boolean variables can only have two values, TRUE or FALSE. Sometimes we use 1 for TRUE and 0 for FALSE. They are the same.

Boolean functions

AND • Both variables must be true.

Fruit	Cereal	Fruit • Cereal
F	F	F
F	T	F
T	F	F
T	T	T

OR + One or both variables must be true.

Cake	Ice Cream	Happy?
F	F	F
F	T	T
T	F	T
T	T	T

When there are two variables, there will be four rows, one for each possible combination of TRUE and FALSE: FF, FT, TF, and TT. When there is only one variable, there are two rows, one for FALSE and one for TRUE.

NOT $\overline{\text{}}$ The result is the opposite.

Zucchini	$\overline{\text{Zucchini}}$
F	T
T	F

There are other Boolean functions. Important ones are EXCLUSIVE OR (XOR), NOT-AND (NAND) and NOT-OR (NOR). You can look them up.

Kat needs a cat

"Any cat, as long as it's black!
"Or, a female cat, neutered, either white or orange, or a male cat, neutered, any color but white."

What are the variables? (Remember, 1/0, true/false only)

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Write the whole expression for Kat's ideal cat:

Exercise

A logician goes into a restaurant and says, "I want a hamburger or a hotdog and French fries."
Assume AND takes precedence over OR; the English "or" is exclusive

Write the Boolean expression:

Which of the following possibilities will satisfy the logician's request?

a. just a hamburger
b. just a hotdog
c. just French fries
d. a hotdog and French fries
e. a hamburger and French fries
f. a hotdog and a hamburger
g. all three
h. nothing.

What if OR took precedence over AND? (That's why parentheses are important!)

De Morgan's Theorem

Named after Augustus De Morgan. Describes how **not** is used in coding.
"Break the line, change the sign."

AND form	OR form
$\overline{A \bullet B} = \overline{A} + \overline{B}$	$\overline{A + B} = \overline{A} \bullet \overline{B}$
`!(A && B) = !A || !B`	`!(A || B) =!A && !B`

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