Truth Tables

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Compound statements can be complicated and Truth Tables let you calculate with them.

An example

Professor says: If you get an A on the final, or you get at least 90 on the homework, then you pass this course.

This statement is TRUE provided that the Professor told the truth (didn't lie) – whether or not you get an A in the course.

Analysis

- You get an A in this course (P)
- You get an A on the final (Q)
- You get at least 90 on the homework (R)

The promise is:

`If (Q or R) then P.`

How many possibilities?

Truth Table

A	B	A ⇒ B
T	T	T
T	F	F
F	T	T
F	F	T

$$(Q \vee R) \implies P$$

if … then; ∨ = OR

A on final; 9pon HW; A in course

Q	R	P	Q ∨ R	Q ∨ R ⇒ P
T	T	T	T	T
T	T	F	T	F
T	F	T	T	T
T	F	F	T	F
F	T	T	T	T
F	T	F	T	F
F	F	T	F	T
F	F	F	F	T

Assign T or F to each statement

Count sequences

T, T, F or more generally sequences of length 3 with T or F.

Sequence is an element of

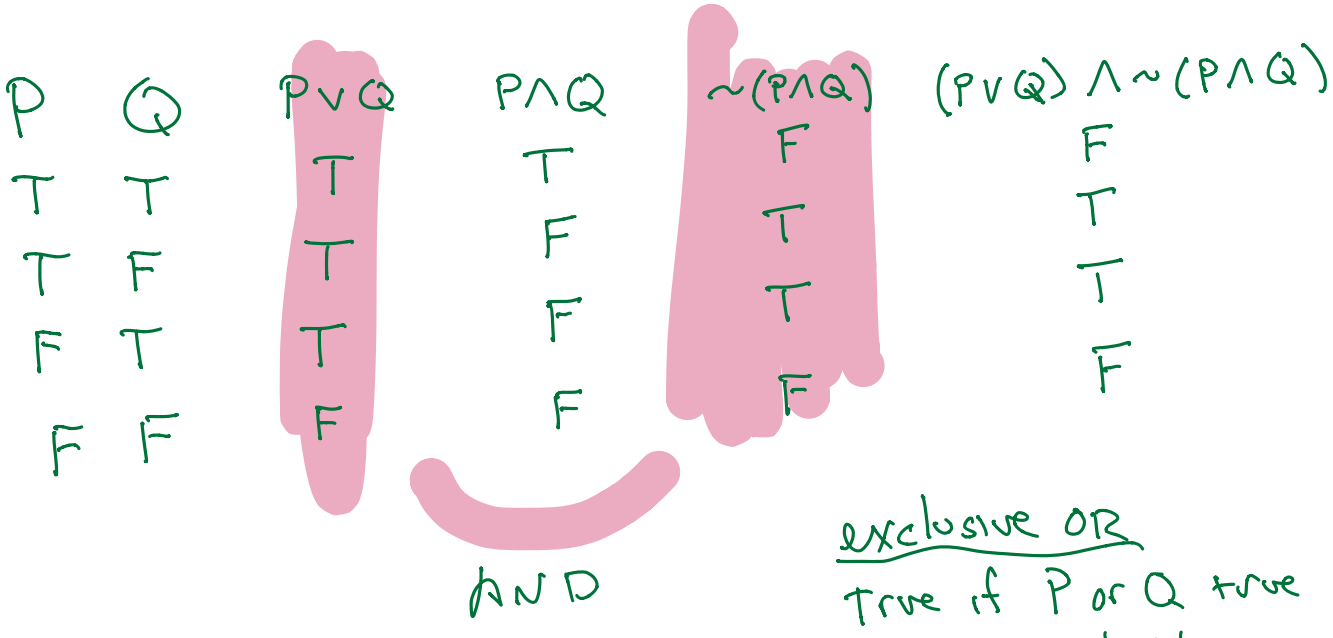
$S = \{T,F\} \times \{T,F\} \times \{T,F\}$

$|S| = 2 \cdot 2 \cdot 2 = 8$

Another example (see the text, Ch2.5)

Let P and Q be any statements. $(P \vee Q) \wedge \sim (P \wedge Q)$ reads as:

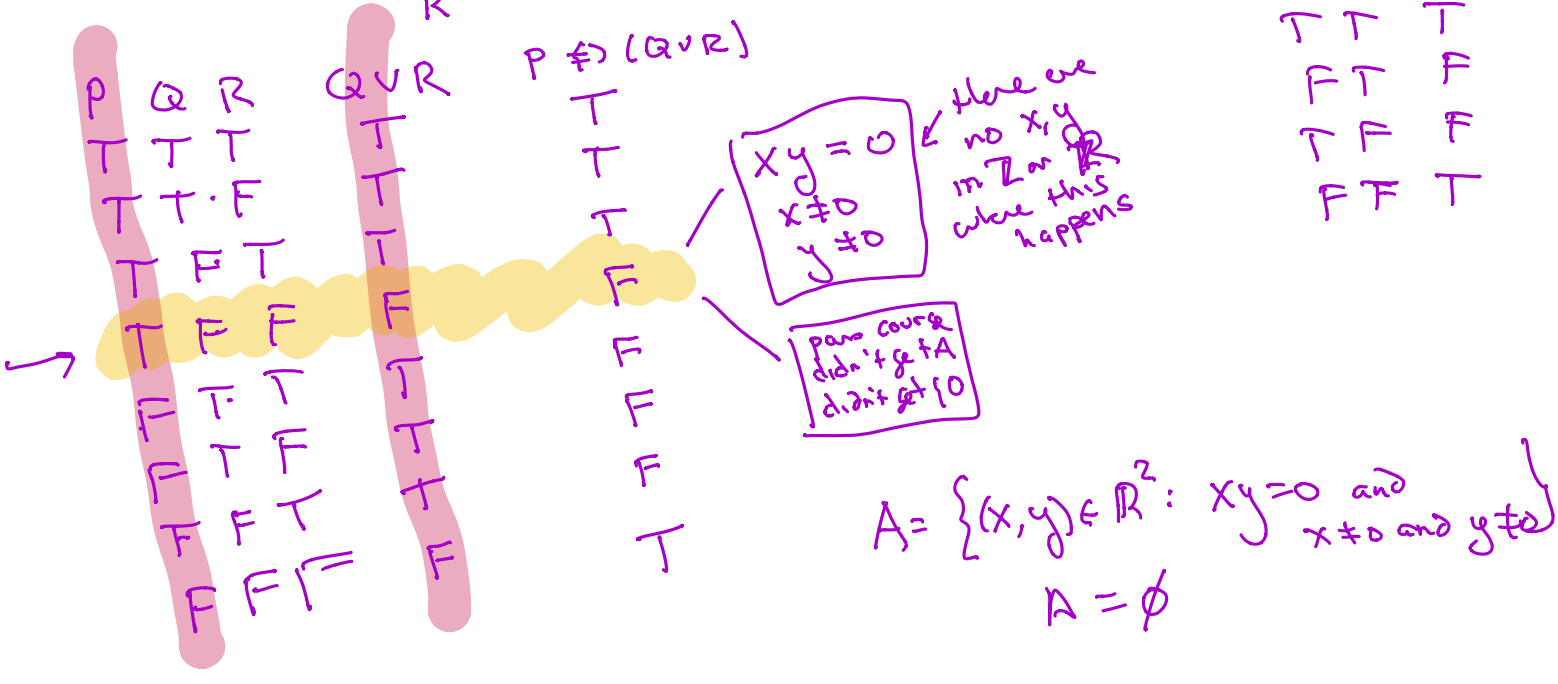
(P OR Q) and NOT (P AND Q).



Example

$P \iff (Q \vee R)$

- $xy = 0$ if and only if $x = 0$ or $y = 0$.
- You will pass this course if and only if you get an A on the final or at least 90 on the homework.



Homework example

always false

Write a truth table for $(P \wedge \sim P) \vee Q$.

P	Q	$P \wedge \sim P$	$(P \wedge \sim P) \vee Q$
T	T	F	T
T	F	F	F
F	T	F	T
F	F	F	F