AP Computer Science A

Logic, Boolean Expressions, and Truth Tables

Practice Examples

Examples 1–5: True or False?

It is given that two Boolean expressions p and q are true and false, respectively. For the following Boolean expressions, identify whether the following expression is true or false.

1. `p && q` False
2. `p || q` True
3. `q || !(3 > 10)` True
4. `!q && (p || q || (0 == 1))` True
5. `!p || (q || (p && (5 >= 10))` False

Examples 6–10: Alternative Expressions

Given two numbers a and b, find an alternative way to express the following Boolean expressions. If the statement is always true, write TAUTOLOGY. IF the statement is always false, write CONTRADICTION.

6. `!(a < b)` (b<=a)
7. `(a < b) || (a >= b)` Tautology.
8. `(a < b) && (a > b)` Contradiction
9. `!(a > b) && !(a >= b)` (a<b)
10. `!(a >= b) || (a == b)` (a<=b)

Examples 11–13: Truth Tables

Given a set of Boolean expressions (p, q, and r), construct a truth table for each of the following logical relations.

11. `p || q`
12. `p || !q`
13. `(p || q) && !r`

Examples 14–15: Logical Equivalences

Given two Boolean expressions p and q, verify the following logical equivalence using a truth table.

14. `p || (p && q)` is logically equivalent to p.
15. `!(p || q)` is logically equivalent to `!p && !q`.

Examples 11-13 Truth Tables

11.

p	q	p||q
T	T	T
T	F	T
F	T	T
F	F	F

12.

p	q	!q	p||!q
T	T	F	T
T	F	T	T
F	T	F	F
F	F	T	T

13

p	q	r	p||q	!r	(p||q)&&!r
T	T	T	T	F	F
T	T	F	T	T	T
T	F	T	T	F	F
T	F	F	T	T	T
F	T	T	T	F	F
F	T	F	T	T	T
F	F	T	F	F	F
F	F	F	F	T	F

14-15

14

p	q	p && q	p || (p && q)
T	T	T	T
T	F	F	T
F	T	F	F
F	F	F	F

same

15

p	q	p || q	! (p || q)	!p	!q	!p && !q
T	T	T	F	F	F	F
T	F	T	F	F	T	F
F	T	T	F	T	F	F
F	F	F	T	T	T	T

same