Evaluating More Complex Boolean Expressions. One tool that can be used to evaluate a Boolean is expression is a Truth Table.

Truth Table for the AND, OR, and NOT logical operators.

P	Q	P && Q	P || Q	!P
True	True			
True	False			
False	True			
False	False			

Operator Precedence

_____ (highest)

_____

_____ (lowest)

Evaluate the following.

! (!B) is equivalent to _____

!a && b == c || d where c is TRUE and a, b, d are FALSE _____

Some Useful Boolean Equivalences

Let a and b represent algebraic value

!(a < b) is equivalent to _____

!(a == b) is equivalent to _____

!(a >= b) is equivalent to _____

c is true, a,b,d false answer the following carefully:

a||b!=c||d==b _____ a || d && c _____

!(a==b) && b || c==d _____ !(a || d) && c _____

a || b || d && c _____ (a&&d) || true _____

!(a || b || d) && c _____ false || !d _____

!(a || b || d) && !c _____ true && !d _____

Let p and q and r represent boolean values

!(p && q) is equivalent to _____

!(p || q) is equivalent to _____

DeMorgan's Laws

Some sample problems.

1) Simplify !(3 <= x && x <= 5)

2) For what values of p and q is this expression TRUE?

(p && q) || !(p || q)

3) What value(s) will this print?

System.out.println(!(x > 10 || x < 20));

4) Simplify !(x != 0 || y != 0)

5) Simplify !(x < 5) || !(x >= 9)

6) When is this expression TRUE?

x > 7 && x < 5 || x > 10

Short-Circuit Evaluation

The JVM sometimes knows the value of a Boolean expression before it has evaluated all of its parts. For instance, in the expression

(p && q)

if p is _____, then the whole expression must be _____ (and the JVM will not bother to evaluate q).

In the same way, in this expression:

(p || q)

if p is _____, then the whole expression must be _____ (and the JVM will not bother to evaluate q).

1)	If x has a value of zero, what happens?	int x;
		// x is assigned a value
		if (x > 4 || 10.0 / (x - 5) > 0)
		System.out.println("A");
		else if (10 / x < 0 || x > 10)
		System.out.println("B");
		else if (x > 5 && 1.0/(x - 3) > 0)
		System.out.println("C");
		else
		System.out.println("D");

2)	If x has a value of 5, what happens?	
3)	If x has a value of 3, what happens?	

Higher precedence: && or || you must know this!

Writing equivalent statements. Show the truth table to prove.

1. !(p && q) && (p || q)

2. !((p || q) && (q || !r))

3. Given this statement: (a < c) || !((c == a*b) && (c < a))

what are possible values of a, b, c that will make this true? (ie.. a>c is false, etc)

will a truth table help? or assign values to parts of the statement?

4. Rewrite this statement more explicitly to show order:

!A && B || C

6) Complete the Truth Table

P	Q	R	Q && R	P || (Q && R)
True	True	False		
False	False	True		

7) Complete the Truth Table

P	Q	R	P && Q	P && R	(P && Q) || (P && R)
True	False	True			
False	False	True			

8) List all the values of p, q, and r (where p, q, and r are boolean variables) that make this expression TRUE. Can use a truth table.

!p && (q || r)

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9) List all the values of x that make this expression TRUE. Assume x is an int.

!(x > 5 && x <= 15)

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10) Simplify (where p and q are boolean variables)

!(!p && q) _____

11) Simplify (where p and q are boolean variables)

!(p || !q) _____

12) If a boolean expression involved four different independent boolean variables/expressions (e.g. p, q, r, and s), how many different rows (i.e. combinations of values) would the Truth Table contain?

13) The boolean expression !A && B || C is equivalent to

a) !A && (B || C)
b) ((!A) && B) || C
c) (!A) && (B || C)
d) !(A && B) || C
e) !(A && B || C)

14) Assume that a and b are integers. The boolean expression

!(a <= b) && (a*b > 0)

will always evaluate to true given that

a) a = b
b) a > b
c) a < b
d) a > b and b > 0
e) a > b and b < 0

15) Given that a, b, and c are integers, consider the boolean expression

(a < b) || !((c == a*b) && (c < a))

Which of the following will guarantee that the expression is true?

a) c < a is false
b) c < a is true
c) a < b is false
d) c == a * b is true
e) c == a * b is true, and c < a is true

16) If *c* and *d* are boolean variables, which one of the answer choices is NOT equivalent to the following expression?

(c && d) != (c || d)

a) (c && !d) || (!c && d)
b) (c || d) && (!c && !d)
c) (c || d) && (!c || !d)
d) (c || d) && !(c && d)
e) c != d

17) Select the TRUE statement.
a) there will be a compiler error due to 50/x
b) there will be a run-time error due to 50/x
c) the code will run and "ok" will be displayed.
d) the code will run and "ok" will NOT be displayed.
	int x = 0;
	boolean alive = true;
	if (alive || 50 / x != 0)
	System.out.println("ok");

18) m1 and m2 must each return a boolean. True False
19) If m1 returns true, then method m2 will not be called. True False
20) If m1 returns false, then method m2 will not be called. True False
	if (m1() && m2())
	// code A
	else
	// code B

Precedence Chart with Logical Operators – Unit 3

Grouping	()	N/A
Method selector	.	left to right
unary plus/minus/not	+ - !	N/A
multiplicative	* / %	left to right
additive	+ -	left to right
relational operators	< <= > >= == !=	N/A
And	&&	left to right
Or	||	left to right
Assignment Operators	= += *= -= /= %=	right to left