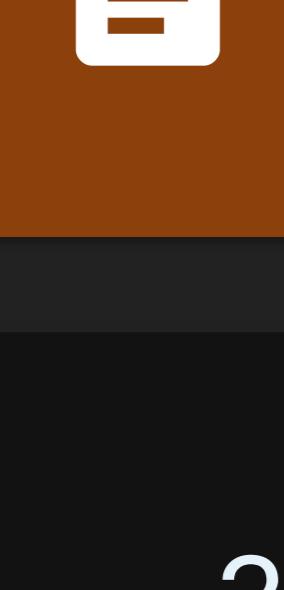


↑ 3.8 Common branching errors



Students:
Section 3.9 is a part of 1 assignment: **CSC108 CH03.1-3.10 P3A**

This assignment's due date has passed. Activity will still be recorded, but will not count towards this assignment (unless the due date is changed). See [this article](#) for more info.

Includes: PA
Due: 02/20/2025, 11:59 PM EST

3.9 Order of evaluation

Precedence rules

The order in which operators are evaluated in an expression are known as **precedence rules**. Arithmetic, logical, and relational operators are evaluated in the order shown below.

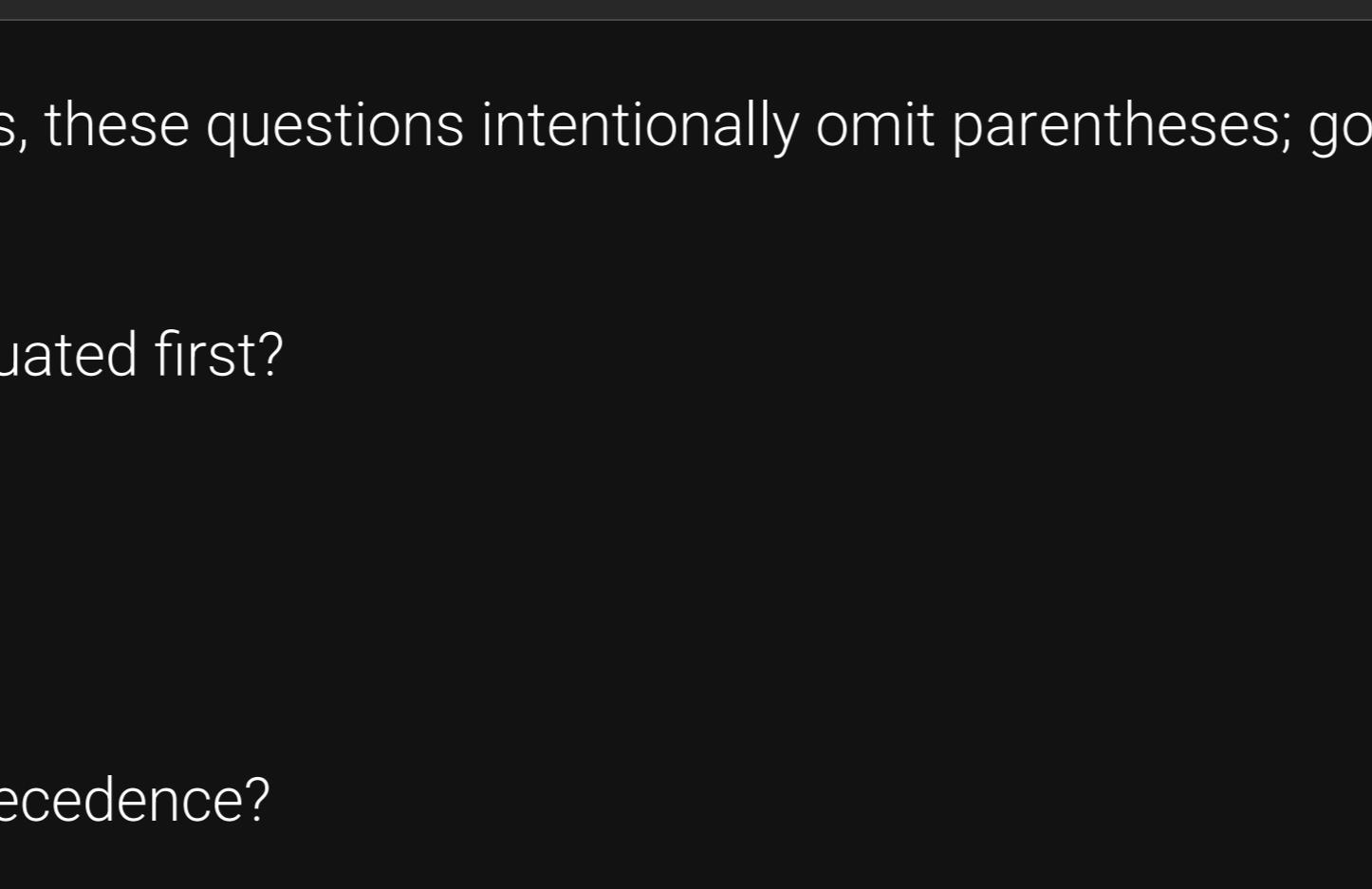
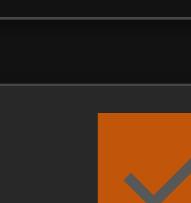
Table 3.9.1: Precedence rules for arithmetic, logical, and relational operators.

Operator/Convention	Description	Explanation
()	Items within parentheses are evaluated first	In $(a * (b + c)) - d$, the $+$ is evaluated first, then $*$, then $-$.
!	! (logical NOT) is next	$! x \mid\mid y$ is evaluated as $(!x) \mid\mid y$
* / % + -	Arithmetic operators (using their precedence rules; see earlier section)	$z = 45 * y < 53$ evaluates $*$ first, then $<$, then $-$.
< <= > >=	Relational operators	$x < 2 \mid\mid x >= 10$ is evaluated as $(x < 2) \mid\mid (x >= 10)$ because $<$ and $>=$ have precedence over $\mid\mid$.
== !=	Equality and inequality operators	$x == 0 \&\& x != 10$ is evaluated as $(x == 0) \&\& (x != 10)$ because $==$ and $!=$ have precedence over $\&\&$. $==$ and $!=$ have the same precedence and are evaluated left to right.
&&	Logical AND	$x == 5 \mid\mid y == 10 \&\& z != 10$ is evaluated as $(x == 5) \mid\mid ((y == 10) \&\& (z != 10))$ because $\&\&$ has precedence over $\mid\mid$.
	Logical OR	$\mid\mid$ has the lowest precedence of the listed arithmetic, logical, and relational operators.

Feedback?

PARTICIPATION ACTIVITY

3.9.1: Applying the precedence rules to an expression can be thought of as a 'tree'.



Captions ^

- Expressions like $x + 1 > y * z \mid\mid z == 3$ are evaluated using precedence rules. Among $+$, $>$, $*$, $\mid\mid$, and $==$, the $*$ comes first.
- Next comes $+$, then $>$, then $==$, and finally $\mid\mid$.
- The expression is actually treated like a 'tree', evaluated from the bottom upwards.
- If $x = 7$, $y = 6$, and $z = 3$, then $y * z$ is 18. Next, $x + 1$ is 8. Next, $8 > 18$ is false. Next, $z == 3$ is true. Finally, $false \mid\mid true$ is true.

Feedback?

PARTICIPATION ACTIVITY

3.9.2: Order of evaluation.



To teach precedence rules, these questions intentionally omit parentheses; good style would use parentheses to make order of evaluation explicit.

- 1) Which operator is evaluated first?

- $\&\&$
- !

- 2) Which operator has precedence?

- +
-
- >
- *

- 3) In what order are the operators evaluated?

- +, !=, &, &&
- +, -, &&, !=
- +, -, !=, &

- 4) To what does this expression evaluate, given int x = 4, int y = 7.

- true
- false

Feedback?

Common error: Missing parentheses

A common error is to write an expression that is evaluated in a different order than expected. Good practice is to use parentheses in expressions to make the intended order of evaluation explicit. Several examples are below.

PARTICIPATION ACTIVITY

3.9.3: Common errors in expressions.



- 1) Does $! x == 3$ evaluate as $!(x == 3)$?

- Yes
- No

- 2) Does $w + x == y + z$ evaluate as $(w + x) == (y + z)$?

- Yes
- No

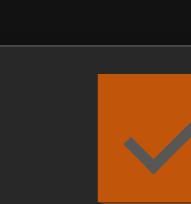
- 3) Does $w \&\& x == y \&\& z$ evaluate as $(w \&\& x) == (y \&\& z)$?

- Yes
- No

Feedback?

PARTICIPATION ACTIVITY

3.9.4: Order of evaluation.



Which illustrates the actual order of evaluation via parentheses?

- 1) $! green == red$

- !(green) == red
- !(green == red)
- !(green) = red

- 2) $bats < birds \mid\mid birds < insects$

- ((bats < birds) \mid\mid birds) < insects
- bats < (birds \mid\mid birds) < insects
- (bats < birds) \mid\mid (birds < insects)

- 3) $! (bats < birds) \mid\mid (birds < insects)$

- !(bats < birds) \mid\mid (birds < insects)
- (! (bats < birds)) \mid\mid (birds < insects)
- ((bats < birds) \mid\mid birds) < insects

- 4) $(num1 == 9) \mid\mid (num2 == 0) \&\& (num3 == 0)$

- (num1 == 9) \mid\mid ((num2 == 0) \&\& (num3 == 0))
- ((num1 == 9) \mid\mid (num2 == 0)) \&\& (num3 == 0)
- (num1 == 9) \mid\mid (num2 == (0 \&\& num3) == 0)

Feedback?

Common error: Math expression for range

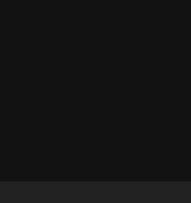
A common error often made by new programmers is to write expressions like $(16 < age < 25)$, as one might see in mathematics.

The meaning, however, almost certainly is not what the programmer intended. Suppose age is presently 28. The expression is evaluated left-to-right, so evaluation of $16 < age$ yields true. Next, the expression $true < 25$ is evaluated; clearly not the programmer's intent. However, true is actually 1, and evaluating $1 < 25$ will yield true. Thus, the above expression evaluates to true, even for ages greater than 25.

Thus, $16 < age < 25$ is actually the same as $(16 < age) < 25$, which evaluates to $(true) < 25$ for any age over 16, which is the same as $(1) < 25$, which evaluates to true. The correct way to do such a comparison is: $(age > 16) \&\& (age < 25)$.

PARTICIPATION ACTIVITY

3.9.5: Expression for detecting a range.



- 1) A programmer erroneously wrote an expression as: $0 < x < 10$. Rewrite the expression using logical AND. Use parentheses.

$(0 < x) \mid\mid (x < 10)$

Check Show answer

Feedback?

Common error: Bitwise rather than logical operators

Logical AND is $\&\&$ and not just $\&$, and logical OR is $\mid\mid$ and not just \mid . $\&$ and \mid represent **bitwise operators**, which perform AND or OR on corresponding individual bits of the operands.

A common error is to use a bitwise operator instead of a logical operator, typing $\&$ instead of $\&\&$, or typing \mid instead of $\mid\mid$. A bitwise operator may yield different behavior than expected.

PARTICIPATION ACTIVITY

3.9.6: Bitwise vs. logical operators.



Indicate if the expression correctly uses logical operators.

- 1) $(x > 5) \& (y > 3) \& (z != 0)$

- Yes
- No

- 2) $(x == 0) \mid\mid (y == 0) \mid (z == 0)$

- Yes
- No

- 3) $((x == y) \&\& (y == z)) \mid\mid (w == 0)$

- Yes
- No

Feedback?

How was this section? Provide section feedback

Activity summary for assignment: CSC108 CH03.1-3.10 P3A

Due: 02/20/2025, 11:59 PM EST

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163 / 163 points

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Completion details ^

↓ 3.10 Example: Toll calculation