Boolean Data Type

zyBook Chap 4.12

Boolean

- A data type whose values are **true** and **false**
- Boolean expressions are commonly used for **logical tests**
- It is legal to
  - create a boolean **variable**
  - pass a boolean value as a **parameter**
  - **return** a boolean value from methods
  - call a method that returns a boolean and use it as a test

Equality & Relational & Logical Operators

zyBook Chap 4.2, 4.4, 4.5, 4.10

Equality and Relational Operators

- Compare two expressions
- Result in boolean (true or false)
- Only use with **primitive data**

Operator	Description	Example	Result
==	Equal to	2 + 2 == 4	true
!=	Not equal to	3.2 != 4.1	true
<	Less than	4 < 3	false
>	Greater than	4 > 3	true
<=	Less than or equal to	2 <= 0	false
>=	Greater than or equal to	2.5 >= 2.5	true

Logical Operators

- Conditions can be combined with logical operators

Operator	Description	Example	Result
`&&`	AND	`(2 == 3) && (-1 < 5)` `false && true`	`false`
`||`	OR	`(2 == 3) || (-1 < 5)` `false || true`	`true`
`!`	NOT	`!(2 == 3)` `!(false)`	`true`

- We use truth tables to evaluate logical operators.

p	q	!p	p && q	p || q
true	true	false	**true**	true
true	false	false	false	true
false	true	true	false	true
false	false	true	false	**false**

“Exclusive OR” vs. “Inclusive OR”

- OR in natural language
  - Exclusive OR
    - A OR B
    - Case 1: A is true
    - Case 2: B is true

- **OR in programming** language
  - **Inclusive OR**
    - **A OR B**
    - Case 1: A is true
    - Case 2: B is true
    - Case 3: Both A and B are true

Precedence

If two operations are at the same precedence order, evaluate from left to right with the exception of assignment operators that are evaluated right to left.

1. Parentheses: ()
2. Unary operators: +, -, **!**
3. Multiplicative operators: *, /, %
4. Additive operators: +, -
5. **Relational operators: <, >, <=, >=**
6. **Equality operators: ==, !=**
7. **Logical AND: &&**
8. **Logical OR: ||**
9. Assignment operators: =, +=, -=, *=, /=, %=

Evaluate → Compare/Combine → Assign

Q: Determine the truth value of

```
false || true && -5 / 2 + (13 + 6) < 19
false || true && -5 / 2 + 19 < 19
false || true && -2 + 19 < 19
false || true && 17 < 19
false || true && true
false || true
true
```

1. Parentheses: ()
2. Unary operators: +, -, !
3. Multiplicative operators: *, /, %
4. Additive operators: +, -
5. Relational operators: <, >, <=, >=
6. Equality operators: ==, !=
7. Logical AND: &&
8. Logical OR: ||
9. Assignment operators: =, +=, -=, *=, /=, %=