Logical Operators

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Objectives

- To combine conditions using logical operators (**&&**, **||**, and **!**) (§3.10).
- To program using selection statements with combined conditions (**LeapYear**, **Lottery**) (§§3.11–3.12).

Outline

- Discussed
  - Boolean data type and Boolean expressions
  - If-statements (one-way, two-way, multi-way, and nested if-statements) and their flow charts
  - Common errors and pitfalls
  - 3 (“big”) programming problems (subtraction quiz, compute BMI, compute taxes)
- Logical operators
- Two (“big”) programming problems (LeapYear, Lottery)

Logical Operators

Operator	Name	Description
!	not	logical negation
&&	and	logical conjunction
||	or	logical disjunction
^	exclusive or	logical exclusion

Truth Table for Operator !

p	!p	Example (assume age = 24, weight = 140)
true	false	!(age > 18) is false, because (age > 18) is true.
false	true	!(weight == 150) is true, because (weight == 150) is false.

Truth Table for Operator &&

p_1	p_2	p_1 && p_2	Example (assume age = 24, weight = 140)
false	false	false	(age <= 18) && (weight < 140) is false, because both conditions are both false.
false	true	false	
true	false	false	(age > 18) && (weight > 140) is false, because (weight > 140) is false.
true	true	true	(age > 18) && (weight >= 140) is true, because both (age > 18) and (weight >= 140) are true.

Truth Table for Operator | |

p_1	p_2	p_1 || p_2	Example (assume age = 24, weihgt = 140)
false	false	false	
false	true	true	(age > 34) || (weight <= 140) is true, because (age > 34) is false, but (weight <= 140) is true.
true	false	true	(age > 14) || (weight >= 150) is false, because (age > 14) is true.
true	true	true	

Truth Table for Operator ^

p_1	p_2	p_1 ^ p_2	Example (assume age = 24, weight = 140)
false	false	false	(age > 34) ^ (weight > 140) is true, because (age > 34) is false and (weight > 140) is false.
false	true	true	(age > 34) ^ (weight >= 140) is true, because (age > 34) is false but (weight >= 140) is true.
true	false	true	(age > 14) ^ (weight > 140) is true, because (age > 14) is true and (weight > 140) is false.
true	true	false	

Let’s use them in an example …

- Here is a program that checks whether a number is divisible by 2 and 3, whether a number is divisible by 2 or 3, and whether a number is divisible by 2 or 3 but not both

Questions?

The & and | Operators

- Do not confuse them with && and ||
- Optional to understand & and | fully for now

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If x is 1, what is x after this expression?
(x > 1) & (x++ < 10)

If x is 1, what is x after this expression?
(1 > x) && ( 1 > x++)

How about (1 == x) | (10 > x++)?
(1 == x) || (10 > x++)?
```

Questions?

Programming Problem. Determining Leap Year?

- This program first prompts the user to enter a year as an int value and checks if it is a leap year.
- A year is a leap year if it is divisible by 4 but not by 100, or it is divisible by 400.
- (year % 4 == 0 && year % 100 != 0) || (year % 400 == 0)

Programming Problem. Lottery

- Write a program that randomly generates a lottery of a two-digit number, prompts the user to enter a two-digit number, and determines whether the user wins according to the following rule:
  - If the user input matches the lottery in exact order, the award is $10,000.
  - If the user input matches the lottery, the award is $3,000.
  - If one digit in the user input matches a digit in the lottery, the award is $1,000.

Questions?