Chapter 4
Branches

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If-else Branches (General)

- Branching concept
- If
  - Hotel rate example
  - Computing absolute value
- If-else
  - Insurance price
  - Maximum of 2 values
- If-elseif
  - Anniversaries

If statement

- If statement
  - Condition is in parentheses `( )`
    - Evaluates to `true` or `false`
    - Note: 0 evaluates to `false`. Any other number evaluates to `true`
  - Groups of statements are in braces `{ }`
- [Hotel discount](#)
- Operators
  - Equality: `==`
  - Inequality: `!=`

If-else statement

- [Even or odd](#)
- [Writing if-else statements](#)

Multi-branch if-else

- Anniversaries

Comparing types

- Integer/Character
  - Use relational and equality operators (==, !=, <, >, <=, >=)
  - Characters are compared via the ASCII numerical encoding
- Floating Point
  - Potentially problematic due to precision
- Strings
  - Comparisons are case sensitive
  - Relational operators (<, >) do work
    - Be careful of non-ASCII characters

Ranges with Branches (general)

- Soccer team determination
- Insurance prices

Ranges with Branches

- [Relational operators](#)
- [Insurance prices](#)
- Practice
  - [Determine the range](#)
  - [Fill in the blanks](#)

Logical operators (general)

- Logical operators: operate on true and false values
  - AND, OR, NOT
- Detect if a value is in range
- C/C++ Logical operators
  - Newer versions of C++ also support `and, or`
  - Also note: `&&, ||` are *very* different from `&, |`

Detecting Ranges

- [Cable TV Channels](#)
- [Implicit vs. Explicit ranges](#)

Ranges with Gaps

- Movie ticket prices
- Gaps using logical operators

Multiple features

- [Multiple distinct if statements](#)
- [Nested if-else statements](#)

Common Branching Errors

- [Missing braces](#)
- Incorrect Operators
  - = vs. ==
  - Nonexistent operators (e.g. =>, !<, <>)

Toll Calculation: Time of Day

- [Calculate Based on Time of Day](#)

Time (am/pm)	Time (24 hour)	Toll amount
Before 6:00 am	Before 6:00	1.55
6:00 am to 9:59 am	6:00 to 9:59	4.65
10:00 am to 5:59 pm	10:00 to 17:59	2.35
6:00 pm and after	18:00 and after	1.55

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Toll Calculation: Weekend Rates

Weekdays

Time (am/pm)	Time (24 hour)	Toll amount
Before 6:00 am	Before 6:00	1.55
6:00 am to 9:59 am	6:00 to 9:59	4.65
10:00 am to 5:59 pm	10:00 to 17:59	2.35
6:00 pm and after	18:00 and after	1.55

Weekends

Time (am/pm)	Time (24 hour)	Toll amount
Before 8:00 am	Before 8:00	1.55
8:00 am to 11:59 am	8:00 to 11:59	3.05
12:00 pm to 3:59 pm	12:00 to 15:59	3.45
4:00 pm to 6:59 pm	16:00 to 18:59	3.60
7:00 pm to 9:59 pm	19:00 to 21:59	3.05
10:00 pm and after	22:00 and after	1.55

[Calculate based on Time of Day and Day of Week](#)

Toll Calculation: HOV rules

- A carpool is 3 or more people per vehicle.
- The toll for carpools on weekdays between 6:00 am and 10:00 am is half the normal toll.
- Otherwise, the toll for carpools is 0 (as in free).
- [Calculating toll with discount](#)

Order of Evaluation

- <u>Precedence rules</u>
- Common errors
  - <u>Missing parentheses</u>
  - Expression for range
    - **e.g.** `(16 < age < 25)`
- Bitwise (`&`, `|`) vs. logical (`&&`, `||`) operators

Switch Statements

- More clearly represents multi-branch behavior
- Example
- General form
- Dog Years
- Omitting the break statement

Boolean data type

- Type `bool`
  - Values: `true` or `false`
  - Can be set explicitly
    - `bool isStudent = true;`
    - `bool isTeacher = false;`
  - Set via expression
    - `bool isHot = (fahrenheitTemperature > 80);`
- [Use to simplify expressions](#)

String comparisons

- Equality
  - Same number of characters
  - Each corresponding character is identical
- Relational
  - Compared alphabetically

Character Operations

- #include <cctype>
- Some examples
  - `isalpha()`
  - `isdigit()`
  - `isspace()`
  - `toupper()`
  - `tolower()`
- See http://www.cplusplus.com/reference/cctype/
- Example: State abbreviations

String access operations

- <u>Character indices</u>
  - `at()` (also `[]`)
  - <u>Word scramble</u>
- <u>Changing a character</u>
- Other string functions
  - `size()`, `length()`
  - `append()`
  - <u>Adding punctuation</u>
- Common Errors
  - <u>Out of range access</u>

More string operations

- Find, substring
  - Get username from email address
- Combining/replacing
  - Greeting
- https://cplusplus.com/reference/string/string/

Conditional (ternary) expressions

- Format
- Examples

Floating-point comparison

- [The issue](#)
- Instead of using ==, use "close enough"
  - ```
    if (fabs(x - y) < 0.0001) {
        // presumed equal
    }
    ```
- [Body temperature example](#)

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Short circuit evaluation

- In logical expressions (`a && b, c || d`) evaluation stops if the expression's value is already determined
  - Example
  - Practice
- Example of useful application:
  - ```
    if ((word.length() > 0) && (isupper(word.at(0))) {
        // This string is uppercase
    }
    ```
- Notes
  - Don't overuse if it makes the code confusing
  - Be careful of side effects

In-class Labs

- Interstate Highway Number
- Exact Change
- Name format