

# Decision Structures

## Lecture 10 Sections 4.2 - 4.6

Robb T. Koether

Hampden-Sydney College

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- 1 The `if` Statement
- 2 Nested `if` Statements
- 3 Sequential `if` Statements
- 4 Examples
- 5 Assignment

# Outline

- 1 The `if` Statement
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# The `if` Statement

## The `if` Statement

```
if (boolean-expression)  
{  
    action  
}
```

- The `if` statement allows a programmer to decide whether to perform a specified action.
- The decision is based on a boolean expression.

# The `if` Statement

- This simple form of the `if` statement makes a **one-way decision**.
- The *action* is performed if the *boolean-expression* is true. Otherwise, it is not performed.
- In either case, execution continues with the first statement following the `if` block.

# The Action Part

- The *action* consists of one or more C++ statements.
- If the *action* consists of exactly one statement, then the braces are not necessary.
- The action should be indented one tab stop from the **if** statement.

# Example

## Example (One-Way `if` Statement)

```
float shipping = 0.00;  
if (order < 100.00)  
    shipping = 5.00;
```

order < 100.00	shipping
<b>true</b>	
<b>false</b>	

# Example

## Example (One-Way `if` Statement)

```
float shipping = 0.00;  
if (order < 100.00)  
    shipping = 5.00;
```

order < 100.00	shipping
<b>true</b>	5.00
<b>false</b>	



# Example

## Example (One-Way `if` Statement)

```
float shipping = 0.00;  
if (order < 100.00)  
    shipping = 5.00;
```

order < 100.00	shipping
<b>true</b>	5.00
<b>false</b>	0.00

# The **if-else** Statement

## The **if-else** Statement

```
if (boolean-expression)  
{  
    true-action  
}  
else  
{  
    false-action  
}
```

- The **if-else** statement allows a programmer to decide which of two alternative actions to perform.

# The `if-else` Statement

- This form of the `if` statement makes a **two-way decision**.
- If the *boolean-expression* is true, then the *true-action* is performed.
- If the *boolean-expression* is false, then the *false-action* is performed.

# Example

## Example (Two-Way `if` Statement)

```
float shipping;  
if (order >= 100.00)  
    shipping = 0.00;  
else  
    shipping = 5.00;
```

order >= 100.00	shipping
<b>true</b>	
<b>false</b>	

# Example

## Example (Two-Way `if` Statement)

```
float shipping;  
if (order >= 100.00)  
    shipping = 0.00;  
else  
    shipping = 5.00;
```

order >= 100.00	shipping
<b>true</b>	0.00
<b>false</b>	

# Example

## Example (Two-Way `if` Statement)

```
float shipping;  
if (order >= 100.00)  
    shipping = 0.00;  
else  
    shipping = 5.00;
```

order >= 100.00	shipping
<b>true</b>	0.00
<b>false</b>	5.00

# Outline

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# Nested **if** Statements

## Nested **if** Statements

```
if (bool-expr-1)  
{  
    if (bool-expr-2)  
    {  
        action  
    }  
}
```

- The action part of an **if** statement may itself be an **if** statement.



# Example

## Example (Two-Way `if` Statement)

```
if (order >= 100.00)
{
    if (item_on_sale)
        shipping = 0.00;
}
else
    shipping = 5.00;
```

order >= 100.00	item_on_sale	shipping
<b>true</b>	<b>true</b>	
<b>true</b>	<b>false</b>	
<b>false</b>	<b>true</b>	
<b>false</b>	<b>false</b>	

# Example

## Example (Two-Way `if` Statement)

```
if (order >= 100.00)
{
    if (item_on_sale)
        shipping = 0.00;
}
else
    shipping = 5.00;
```

order >= 100.00	item_on_sale	shipping
<b>true</b>	<b>true</b>	0.00
<b>true</b>	<b>false</b>	
<b>false</b>	<b>true</b>	
<b>false</b>	<b>false</b>	

# Example

## Example (Two-Way `if` Statement)

```
if (order >= 100.00)
{
    if (item_on_sale)
        shipping = 0.00;
}
else
    shipping = 5.00;
```

order >= 100.00	item_on_sale	shipping
<b>true</b>	<b>true</b>	0.00
<b>true</b>	<b>false</b>	undefined
<b>false</b>	<b>true</b>	
<b>false</b>	<b>false</b>	

# Example

## Example (Two-Way `if` Statement)

```
if (order >= 100.00)
{
    if (item_on_sale)
        shipping = 0.00;
}
else
    shipping = 5.00;
```

order >= 100.00	item_on_sale	shipping
<b>true</b>	<b>true</b>	0.00
<b>true</b>	<b>false</b>	undefined
<b>false</b>	<b>true</b>	5.00
<b>false</b>	<b>false</b>	5.00

# Nested **if** Statements

## Nested **if** Statements

```
if (bool-expr-1 && bool-expr-2)  
{  
    action  
}
```

- This is logically equivalent to writing a single **if** statement with a compound condition.

# Example

## Example (Two-Way `if` Statement)

```
if (order >= 100.00 && item_on_sale)
    shipping = 0.00;
else
    shipping = 5.00;
```

<code>order &gt;= 100.00</code>	<code>item_on_sale</code>	<code>shipping</code>
<b>true</b>	<b>true</b>	
<b>true</b>	<b>false</b>	
<b>false</b>	<b>true</b>	
<b>false</b>	<b>false</b>	

# Example

## Example (Two-Way `if` Statement)

```
if (order >= 100.00 && item_on_sale)
    shipping = 0.00;
else
    shipping = 5.00;
```

<code>order &gt;= 100.00</code>	<code>item_on_sale</code>	<code>shipping</code>
<b>true</b>	<b>true</b>	0.00
<b>true</b>	<b>false</b>	
<b>false</b>	<b>true</b>	
<b>false</b>	<b>false</b>	

# Example

## Example (Two-Way `if` Statement)

```
if (order >= 100.00 && item_on_sale)
    shipping = 0.00;
else
    shipping = 5.00;
```

<code>order &gt;= 100.00</code>	<code>item_on_sale</code>	shipping
<b>true</b>	<b>true</b>	0.00
<b>true</b>	<b>false</b>	5.00
<b>false</b>	<b>true</b>	5.00
<b>false</b>	<b>false</b>	5.00



# Nested **if** Statements

## Nested **if** Statements

```
if (bool-expr-1)
{
    action-1
}
else
{
    if (bool-expr-2)
    {
        action-2
    }
}
```

- An interesting case arises when we make the false-action of a two-way **if** statement an **if** statement.

# Nested **if** Statements

- Under exactly what conditions will *action-1* be executed?
- Under exactly what conditions will *action-2* be executed?
- Under exactly what conditions will neither be executed?
- Under exactly what conditions will both be executed?

# Nested **if** Statements

## Nested **if** Statements

```
if (bool-expr-1)  
{  
    action-1  
    {  
else if (bool-expr-2)  
    {  
        action-2  
    }  
}
```

- It is customary to write such a statement in the above form.
- This form may be extended to any number of cases (“actions”).

# Example

## Example (Two-Way `if` Statement)

```
if (order >= 100.00)
    shipping = 0.00;
else if (item_on_sale)
    shipping = 2.00;
else
    shipping = 5.00;
```

<code>order &gt;= 100.00</code>	<code>item_on_sale</code>	<code>shipping</code>
<b>true</b>	<b>true</b>	
<b>true</b>	<b>false</b>	
<b>false</b>	<b>true</b>	
<b>false</b>	<b>false</b>	

# Example

## Example (Two-Way `if` Statement)

```
if (order >= 100.00)
    shipping = 0.00;
else if (item_on_sale)
    shipping = 2.00;
else
    shipping = 5.00;
```

<code>order &gt;= 100.00</code>	<code>item_on_sale</code>	<code>shipping</code>
<b>true</b>	<b>true</b>	0.00
<b>true</b>	<b>false</b>	
<b>false</b>	<b>true</b>	
<b>false</b>	<b>false</b>	

# Example

## Example (Two-Way `if` Statement)

```
if (order >= 100.00)
    shipping = 0.00;
else if (item_on_sale)
    shipping = 2.00;
else
    shipping = 5.00;
```

<code>order &gt;= 100.00</code>	<code>item_on_sale</code>	shipping
<b>true</b>	<b>true</b>	0.00
<b>true</b>	<b>false</b>	0.00
<b>false</b>	<b>true</b>	
<b>false</b>	<b>false</b>	

# Example

## Example (Two-Way `if` Statement)

```
if (order >= 100.00)
    shipping = 0.00;
else if (item_on_sale)
    shipping = 2.00;
else
    shipping = 5.00;
```

<code>order &gt;= 100.00</code>	<code>item_on_sale</code>	shipping
<b>true</b>	<b>true</b>	0.00
<b>true</b>	<b>false</b>	0.00
<b>false</b>	<b>true</b>	2.00
<b>false</b>	<b>false</b>	

# Example

## Example (Two-Way `if` Statement)

```
if (order >= 100.00)
    shipping = 0.00;
else if (item_on_sale)
    shipping = 2.00;
else
    shipping = 5.00;
```

<code>order &gt;= 100.00</code>	<code>item_on_sale</code>	shipping
<b>true</b>	<b>true</b>	0.00
<b>true</b>	<b>false</b>	0.00
<b>false</b>	<b>true</b>	2.00
<b>false</b>	<b>false</b>	5.00



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# Sequential **if** Statements

## Sequential **if** Statements

```
if (bool-expr-1)  
{  
    action-1  
}  
if (bool-expr-2)  
{  
    action-2  
}
```

- We may write separate **if** statements sequentially.

# Sequential `if` Statements

- Under exactly what conditions will *action-1* be executed?
- Under exactly what conditions will *action-2* be executed?
- Under exactly what conditions will neither be executed?
- Under exactly what conditions will both be executed?

# Example

## Example (Two-Way `if` Statement)

```
float shipping = 5.00;  
if (order >= 100.00)  
    shipping -= 3.00;  
if (item_on_sale)  
    shipping -= 2.00;
```

<code>order &gt;= 100.00</code>	<code>item_on_sale</code>	<code>shipping</code>
<b>true</b>	<b>true</b>	
<b>true</b>	<b>false</b>	
<b>false</b>	<b>true</b>	
<b>false</b>	<b>false</b>	

# Example

## Example (Two-Way `if` Statement)

```
float shipping = 5.00;  
if (order >= 100.00)  
    shipping -= 3.00;  
if (item_on_sale)  
    shipping -= 2.00;
```

<code>order &gt;= 100.00</code>	<code>item_on_sale</code>	shipping
<b>true</b>	<b>true</b>	0.00
<b>true</b>	<b>false</b>	
<b>false</b>	<b>true</b>	
<b>false</b>	<b>false</b>	

# Example

## Example (Two-Way `if` Statement)

```
float shipping = 5.00;  
if (order >= 100.00)  
    shipping -= 3.00;  
if (item_on_sale)  
    shipping -= 2.00;
```

<code>order &gt;= 100.00</code>	<code>item_on_sale</code>	shipping
<b>true</b>	<b>true</b>	0.00
<b>true</b>	<b>false</b>	2.00
<b>false</b>	<b>true</b>	
<b>false</b>	<b>false</b>	

# Example

## Example (Two-Way `if` Statement)

```
float shipping = 5.00;  
if (order >= 100.00)  
    shipping -= 3.00;  
if (item_on_sale)  
    shipping -= 2.00;
```

<code>order &gt;= 100.00</code>	<code>item_on_sale</code>	shipping
<b>true</b>	<b>true</b>	0.00
<b>true</b>	<b>false</b>	2.00
<b>false</b>	<b>true</b>	3.00
<b>false</b>	<b>false</b>	

# Example

## Example (Two-Way `if` Statement)

```
float shipping = 5.00;  
if (order >= 100.00)  
    shipping -= 3.00;  
if (item_on_sale)  
    shipping -= 2.00;
```

<code>order &gt;= 100.00</code>	<code>item_on_sale</code>	<code>shipping</code>
<b>true</b>	<b>true</b>	0.00
<b>true</b>	<b>false</b>	2.00
<b>false</b>	<b>true</b>	3.00
<b>false</b>	<b>false</b>	5.00



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# Examples

- Examples

- `PassingScore.cpp`
- `EvaluateScore.cpp`
- `AssignGrade.cpp`

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# Assignment

## Assignment

- Read Sections 4.2 - 4.6.