

Conditional Statements

15-110 Summer 2010
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Conditional statements

- Within a method, we can alter the *flow of control* (the order in which statements are executed) using either conditionals or loops.
- The *conditional statements* `if`, `if-else`, and `switch` allow us to choose which statement will be executed next.
- Each choice or decision is based on the value of a boolean expression (also called the *condition*).

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The `if` statement

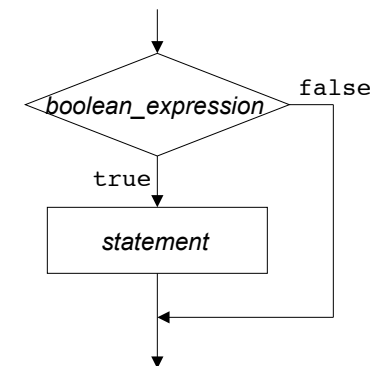
- If we have code that we sometimes want to execute and sometimes we want to skip we can use the `if` statement.
- The form of the `if` statement is
`if (boolean_expression)
statement`
- If `boolean_expression` evaluates to `true`, then `statement` is executed.
- If `boolean_expression` evaluates to `false`, then `statement` is skipped.
- Note that the `boolean_expression` enclosed in parentheses must evaluate to true or false.

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The `if` Flowchart



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if-Statement Examples

```
if (count > 0)
    average = total / count;

if (age >= 26)
    if (hasLicense == true)
        System.out.println("You may rent a car.");

daysInFeb = 28;
if (isLeapYear) {
    daysInFeb = 29;
    System.out.println(year + " is a leap year.");
}
```

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The if Statement

- The *statement* in the `if` statement can be any Java statement:
 - A *simple* statement
 - A *compound* statement, such as an `if` statement
 - A *block* statement, a group of statements enclosed in braces `{}`

```
if (zipcode == 15213) {
    city = "Pittsburgh";
    state = "PA";
}
```

Proper indentation
becomes essential!

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The if-else Statement

- If we want to choose between two alternative we use the `if/else` statement:

```
if (boolean_expression)
    statement1
else
    statement2
```

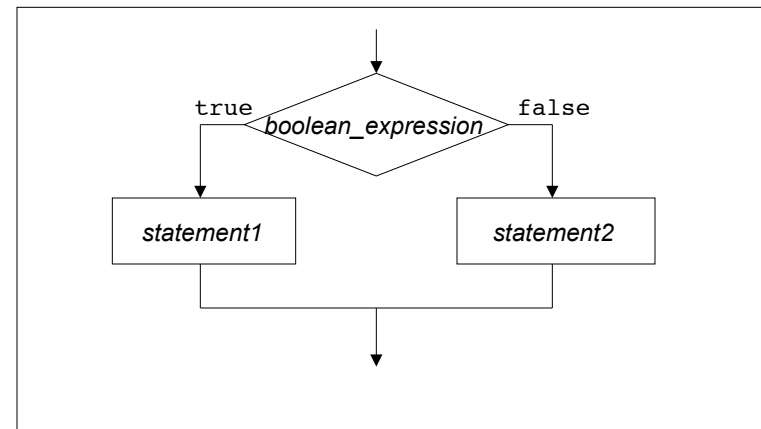
- If `boolean_expression` evaluates to `true`, then `statement1` is executed.
- If `boolean_expression` evaluates to `false`, then `statement2` is executed.

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The if-else Flowchart



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if-else Statement Examples

```
if (temperature <= 32.0) {  
    forecast = "SNOW"; ← The then clause  
}  
else {  
    forecast = "RAIN"; ← The else clause  
}  
  
if (count > 0) {  
    average = total / count;  
}  
else {  
    System.out.println("No data to average.");  
}
```

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Common Error 1

- When you want to test if the value of a variable is in a range.

```
if (0 < temperature < 100) {  
    state = "LIQUID";  
} ← WRONG!!  
  
if (0 < temperature && temperature < 100) {  
    state = "LIQUID";  
} ← Correct
```

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Common Error 2

- When you want to test if the value of a variable is one of two alternates.

```
if (choice == 'M' || 'L') {  
    System.out.println("You're correct!");  
} ← WRONG!!  
  
if (choice == 'M' || choice == 'L') {  
    System.out.println("You're correct!");  
} ← Correct
```

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The *Dangling else* Problem

- When an `if` statement is nested inside the `then` clause of another `if` statement, the `else` clause is paired with the closest `if` statement without an `else` clause.

```
if (x > 0)  
    if (y > 0)  
        color = "red";  
else  
    color = "blue"; ← Misleading indentation
```

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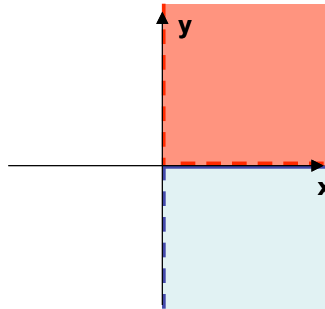
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The *Dangling else* Problem

- In reality it is

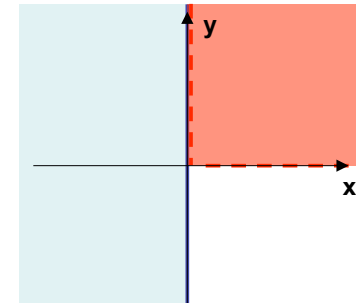
```
if (x > 0)
  if (y > 0)
    color = "red";
  else
    color = "blue";
```



The *Dangling else* Problem

- Use braces to pair else with the outer if

```
if (x > 0) {
  if (y > 0)
    color = "red";
}
else {
  color = "blue";
}
```



- Compare flowcharts!

Multiple Alternatives

- Determine if a number is positive, negative, or zero:

```
if (value < 0) {
  System.out.println("Value is negative.");
}
if (value == 0) {
  System.out.println("Value is zero.");
}
if (value > 0) {
  System.out.println("Value is positive.");
}
```

Computer thinks any combination of the three statements can be executed.

Multiple Alternatives

- Determine if a number is positive, negative, or zero

```
if (value < 0) {
  System.out.println("Value is negative.");
}
else {
  if (value == 0) {
    System.out.println("Value is zero.");
  }
  else {
    if (value > 0) {
      System.out.println("Value is positive.");
    }
  }
}
```

*At most one statement is executed.
Leads to lots of indentation.*

Multiple Alternatives

- Determine if a number is positive, negative, or zero

```
if (value < 0) {  
    System.out.println("Value is negative.");  
}  
else {  
    if (value == 0) {  
        System.out.println("Value is zero.");  
    }  
    else {  
        if (value > 0) {  
            System.out.println("Value is positive.");  
        }  
    }  
}
```

*Remove unnecessary
brackets and re-indent*

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Multiple Alternatives

- Determine if a number is positive, negative, or zero:

```
if (value < 0) {  
    System.out.println("Value is negative.");  
}  
else if (value == 0) {  
    System.out.println("Value is zero.");  
}  
else if (value > 0) {  
    System.out.println("Value is positive.");  
}
```

*At most one statement is executed.
Each choice, however, is at same indentation.*

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Multiple Alternatives

- Determine if a number is positive, negative, or zero:

```
if (value < 0) {  
    System.out.println("Value is negative.");  
}  
else if (value == 0) {  
    System.out.println("Value is zero.");  
}  
else { // value must be positive  
    System.out.println("Value is positive.");  
}
```

It is clear, exactly one statement is executed.

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Multiple Alternatives: Assignments

- Determine the fare: \$2 for a child (no more than 11 years), \$3 for a senior (at least 65 years), or \$5 for an adult.

```
int fare; // fare must be defined  
           // before the if statement  
if (age < 12) {  
    fare = 2;  
}  
else if (age >= 65) { //  
    fare = 5;  
}  
else { // last clause must be  
    fare = 3; // else with no if  
}  
System.out.println("Your fare is $" + fare);
```

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Exercise

- Write a method that prints how many of n1, n2, and n3 are odd:

```
public void printNumOdd(int n1, int n2, int n3) {
```

```
}
```

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Exercise

- Write a method that print whether die1 and die2 are doubles, cat's eyes (two 1's) or neither of these.

```
public void printDoubles(int die1, int die2) {
```

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Programming Style

• Single-line if statement:	<pre>if (y > 0) color = "red";</pre>
• Multi-line if statement:	<pre>if (zipcode == 15213) { city = "Pittsburgh"; state = "PA"; }</pre>
• The if-else statement:	<pre>if (temperature <= 32.0) { forecast = "SNOW"; } else { forecast = "RAIN"; }</pre>
• Multiple alternatives:	<pre>if (value < 0) { valueType = "negative"; } else if (value == 0) { valueType = "zero"; } else { // no if here!! valueType = "positive"; }</pre>

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Testing For Equality

- For **primitive values** use == for equality testing.
- For **objects**, use the **equals** method for testing equal contents.
 - The argument must be the same type as the object on which equals() is called. The method returns true or false depending on whether both objects are "equal" or not.
- For example, let day be an int variable and month be a String variable.

```
if (day == 1 && month.equals("APRIL")) {  
    System.out.println("It's April Fool's Day");  
}
```

*Two String objects are equal if they have **exactly** the same characters, including case and number of characters.*

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Testing for Equality with doubles

- Which statement will Java print?

```
double x = Math.sqrt(2.0);
double y = x * x;

if (y == 2.0) {
    System.out.println("sqrt(2) * sqrt(2) is 2");
}
else {
    System.out.println("sqrt(2) * sqrt(2) "
        + "is not 2. It is " + y);
}
```

Never test for exact equality
with floating point numbers!

Testing for Equality with doubles

- Because of round-off errors, you should test if the numbers are close.

```
double tolerance = 1.0e-10;
double x = Math.sqrt(2.0);
double y = x * x;

if (Math.abs(y - 2.0) < tolerance) {
    System.out.println("sqrt(2) * sqrt(2) is 2");
}
else {
    System.out.println("sqrt(2) * sqrt(2) "
        + "is not 2. It is " + y);
}
```

Short-Circuit Evaluation

- Short circuit evaluation* (or *lazy evaluation*): If the first conditional in an `&&` expression is false, Java does not execute the second conditional.

Example:

```
if (liters > 0 && total/liters > threshold) {
    System.out.println("WARNING: Exceeds threshold");
}
```

What if the expression was an `||` expression?

The switch statement

- If an `if/else` statement with multiple alternatives compares an `int` or `char` variable or expression against several constants you can use a `switch` statement.

Example:

```
switch (suitAsChar) {
    case 'C': suitAsName = "Clubs"; break;
    case 'D': suitAsName = "Diamonds"; break;
    case 'H': suitAsName = "Hearts"; break;
    case 'S': suitAsName = "Spades"; break;
    default: suitAsName = "Unknown";
}
```