Conditional Statements

1301

- 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.

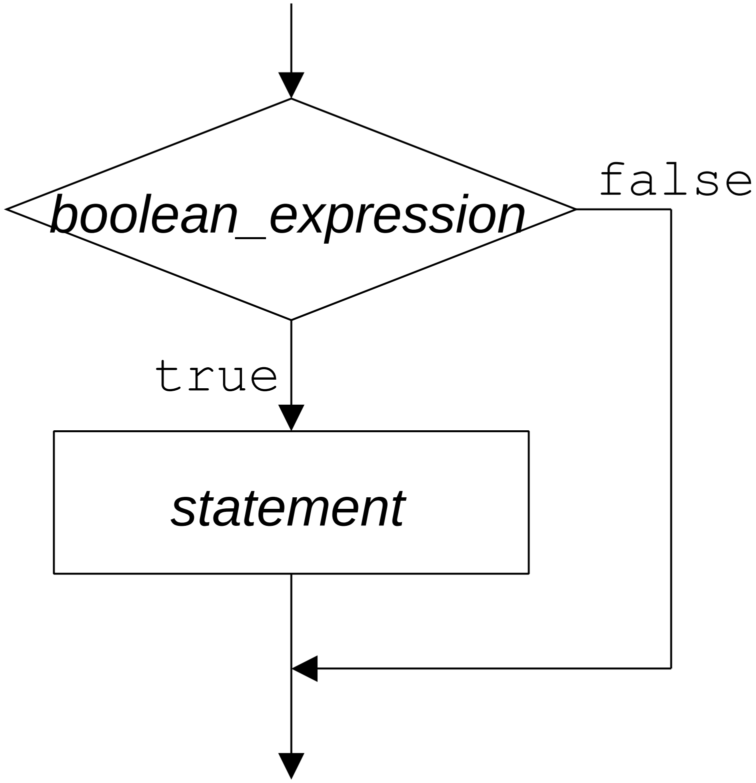
- Each choice or decision is based on the value of a boolean expression (also called the *condition*).

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.

The `if` Flowchart



if-Statement Examples

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

```
  if (age >= 26) !
    !if (hasLicense == true)!
        !System.out.println(“You may rent a car.”);!
```

Or simply `hasLicense`

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

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!

}!

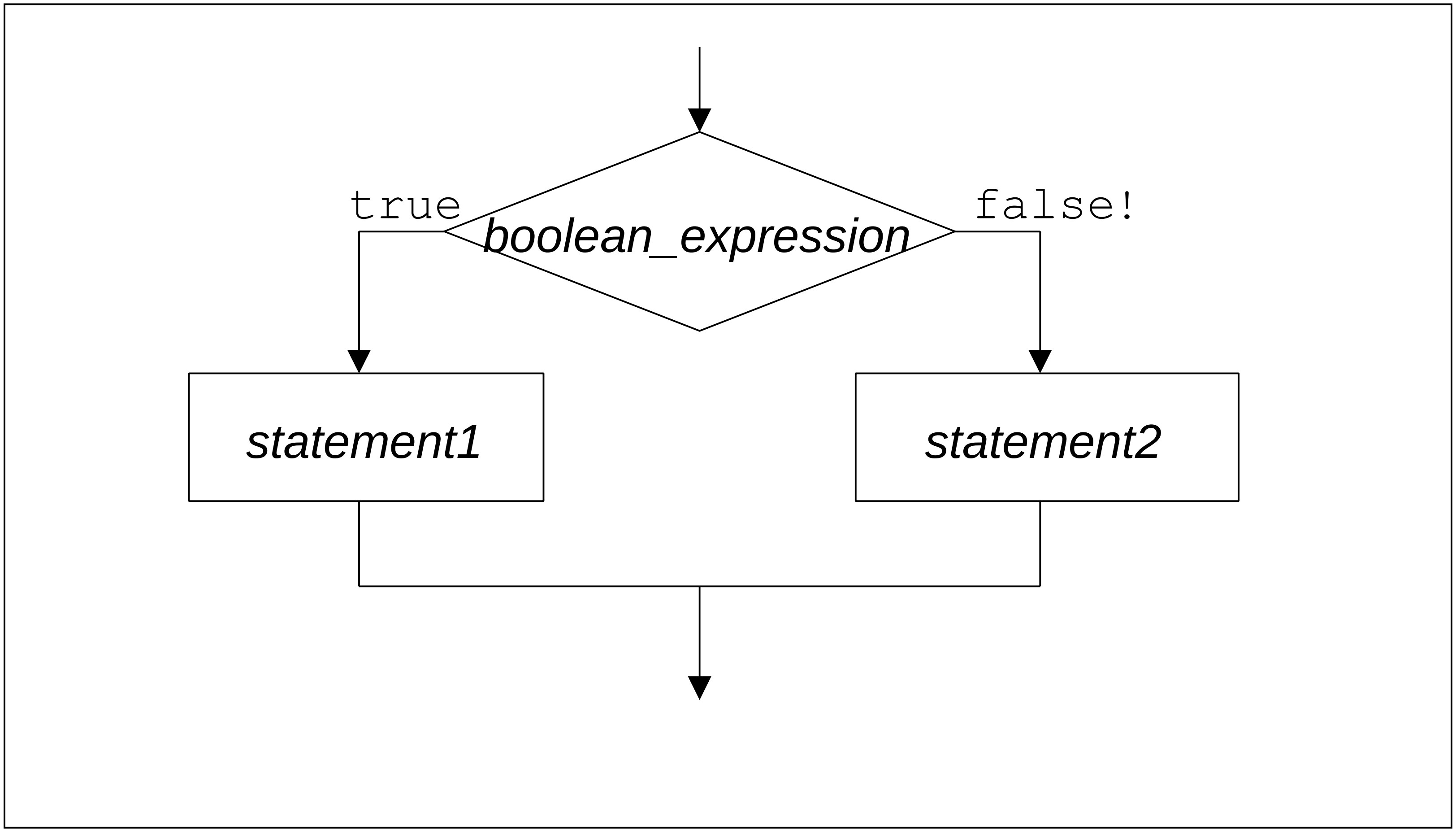
The `if-else` Statement

- 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.

The `if-else` Flowchart



`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.”);!
!}
```

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

Common Error 2

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

```
 !if (choice == ‘M’ || ‘L’) {      ! WRONG!!
 !   System.out.println(“You’re correct!”); !
 !}!

  if (choice == ‘M’ || choice == ‘L’) {      !
     ! System.out.println(“You’re correct!”);
     !
}!                                             Correct
```

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 !
```

Misleading

The *Dangling* `else` Problem

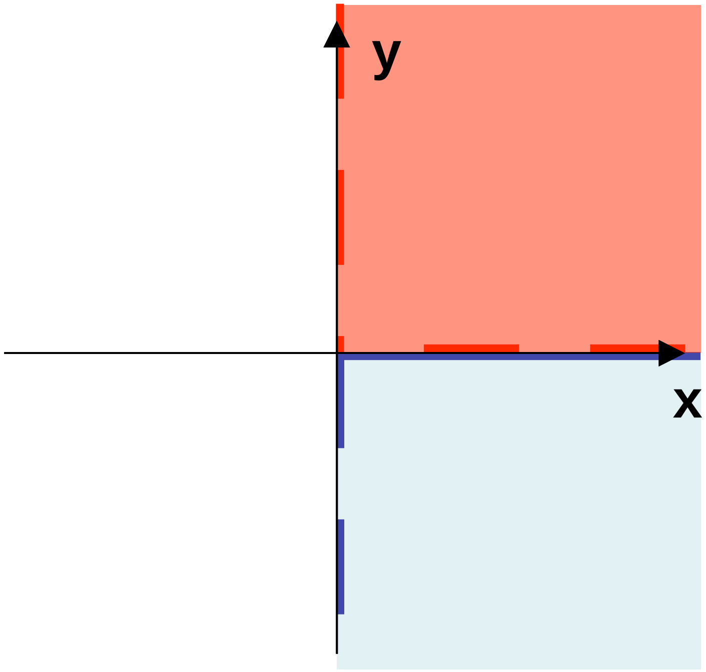
`color = “blue”;` indentation

The *Dangling* `else` Problem

- In reality it is

```
if (x > 0) !      if (y >
0)!
         color = “red”; !
else !

           color = “blue”;
```

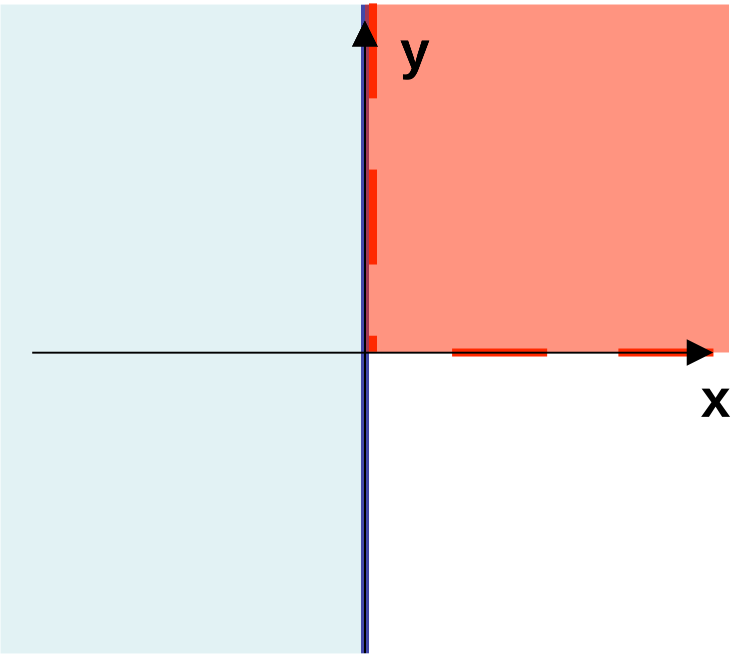


The *Dangling* `else` Problem

- 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***

Multiple Alternatives

the three statements can be executed.

- 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.”);!
 ! !    }!
```

Multiple Alternatives

```
 !   }!
}!
```

*At **most one** statement is executed.*

Leads to lots of indentation.

- 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 {
```

Multiple Alternatives

```
! !    if (value > 0) {!
! ! !      System.out.println(“Value is positive.”);!
! !    }!

!   }
} !
```

Remove unnecessary

brackets and re-indent

- 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.”);!
```

Multiple Alternatives

```
} ! else if (value >
0)  {!
 ! !System.out.println(“Value is positive.”);!
}!
```

At most one *statement is executed.*

Each choice, however, is at same indentation.

- 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.”);!
```

Multiple Alternatives

```
} ! else {  // value must be
positive!
 ! !System.out.println(“Value is positive.”);!
}!
```

*It is clear, **exactly one** statement is executed.*

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;!
if (age ________) {!
 !fare = 2;!
} !
else if (age ___________) { // _________________________!
 !fare = 5;!
} !
else { // ___________________!
 !fare = 3;!
```

fare must be defined before the `if` statement

last clause must be `else` with no `if`

```
}!
System.out.println(“Your fare is $“ + fare);!
```

Exercise

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

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

}!

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) {!

Programming Style

- Single-line if statement:

```
if (y > 0) color =
“red”;!
```

- Multi-line if statement:

```
if (zipcode == 15213) {!
city = “Pittsburgh”;!
    state = “PA”;!
}
```

- The if-else statement:

```
if (temperature <= 32.0) {!
forecast = “SNOW”;   !
} !
else
{!
    forecast = “RAIN”;!
}!
```

- Multiple alternatives:

```
if (value < 0) {!     valueType
= “negative”;!
} ! else if (value ==
0) {!     valueType =
“zero”;! } !
```

```
else {  // no if here!!!
valueType = “positive”;!
}!
```

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*.

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”;!
  }!
```