A Balanced Introduction to Computer Science, 2/E

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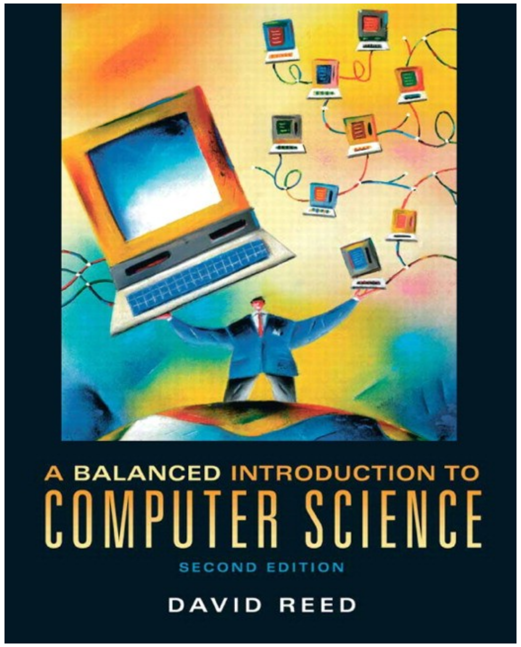
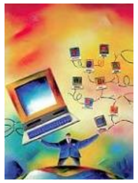


Chapter 11
Conditional Execution

Conditional Execution



so far, all of the code you have written has been *unconditionally executed*

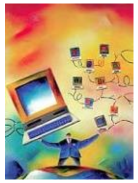
- the browser carried out statements in the same set order

in contrast, many programming tasks require code that reacts differently under varying circumstances or conditions

- e.g., a student's course grade depends upon his/her average
- e.g., an ESP test requires recognizing when a subject guessed right
- e.g., the outcome of a game depends upon die rolls or player moves

conditional execution refers to a program’s ability to execute a statement or sequence of statements only if some condition holds true

If Statements



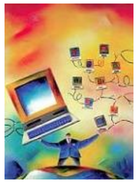
in JavaScript, the simplest form of conditional statement is the *if statement*

- one action is taken if some condition is true, but a different action is taken if the condition is not true (called the *else case*)
- the else case is optional

general form of the if statement:

```
if (BOOLEAN_TEST) {
    STATEMENTS_EXECUTED_IF_TRUE
}
else {
    STATEMENTS_EXECUTED_IF_FALSE
}
```

Braces in If Statements



some people prefer braces on separate lines formatted like this:

```
if (BOOLEAN_TEST)
{
   STATEMENTS_EXECUTED_IF_TRUE
}
else
{
   STATEMENTS_EXECUTED_IF_FALSE
}
```

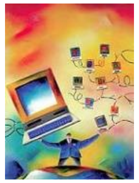
either style is acceptable, but be consistent!

- properly aligning the code (with if-else lining up and statements indented) is central in producing code that is easy to read and modify

technically, you can omit the braces if there is only one statement

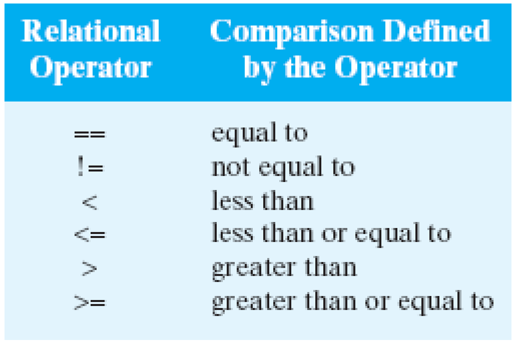
- however, THIS IS STRONGLY DISCOURAGED!
- can lead to tricky errors if the code is ever modified

Boolean Tests



the test that controls an if statement can be any *boolean expression* (i.e., an expression that evaluates to either `true` or `false`)

- boolean tests are formed using *relational operators* because they test the relationships between values



Relational Operator	Comparison Defined by the Operator
==	equal to
!=	not equal to
<	less than
<=	less than or equal to
>	greater than
>=	greater than or equal to

NOTE:

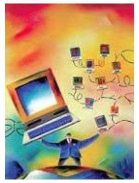
== is for comparisons

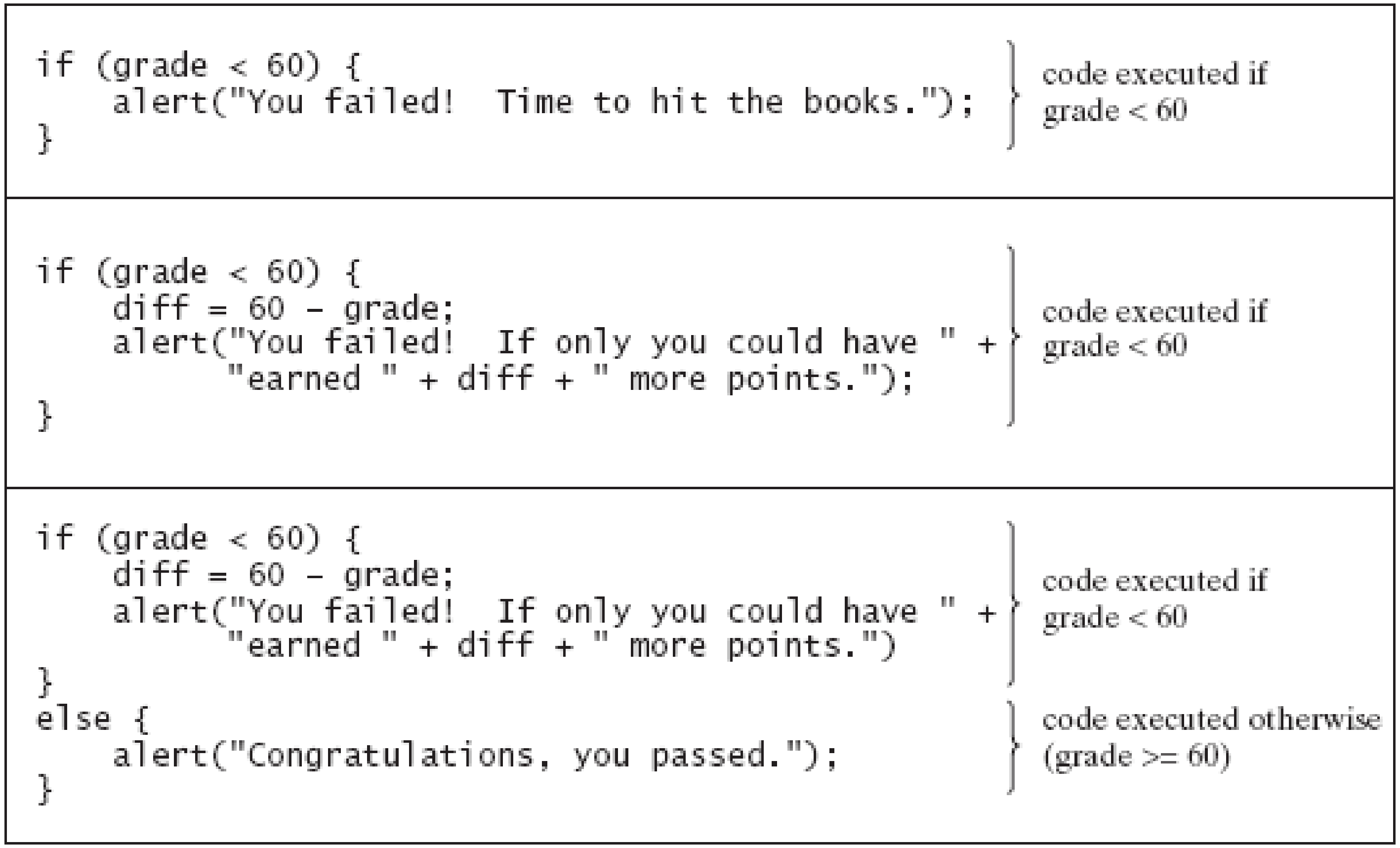
= is for assignments

the boolean test in an if statement determines the code that will be executed

- if the test is true, then the code inside the subsequent curly braces will execute
- if the test is false, then the code inside the curly braces following the else will execute
- note that if the test is false and there is no else case, the program moves on to the statement directly after the if

If Statement Examples





```
if (grade < 60) {
    alert("You failed!  Time to hit the books.");
}
```

code executed if grade < 60

```
if (grade < 60) {
    diff = 60 - grade;
    alert("You failed!  If only you could have " +
          "earned " + diff + " more points.");
}
```

code executed if grade < 60

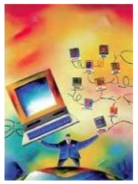
```
if (grade < 60) {
    diff = 60 - grade;
    alert("You failed!  If only you could have " +
          "earned " + diff + " more points.")
}
else {
    alert("Congratulations, you passed.");
}
```

code executed if grade < 60

code executed otherwise (grade >= 60)

an if statement is known as a *control statement*, since its purpose is to control the execution of other statements

Example within a Page



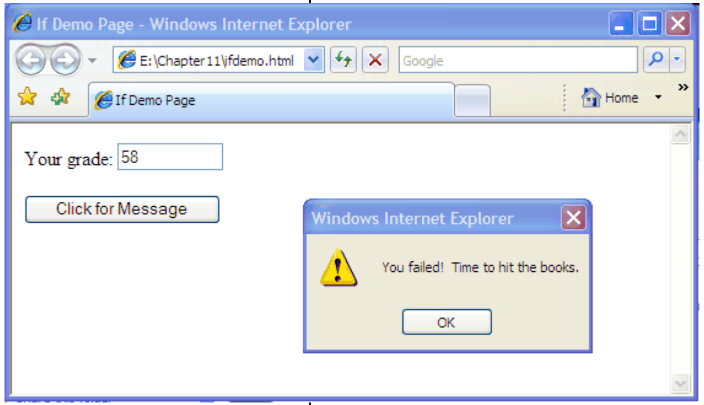
```
<html>
 <!-- ifdemo.html                                 Dave Reed -->
 <!-- This program warns a student of a failing grade. -->
 <!-- ================================================ -->

 <head>
   <title> If Demo Page </title>
   <script type="text/javascript">
     function ShowMessage()
     // Assumes: gradeBox contains a grade
     // Results: displays a warning in response to a failing grade
     {
       var grade;

       grade = document.getElementById("gradeBox").value;
       grade = parseFloat(grade);

       if (grade < 60) {
           alert("You failed!  Time to hit the books.");
       }
     }
   </script>
 </head>

 <body>
   <p>
     Your grade: <input type="text" id="gradeBox" size="10" value="" />
   </p>
   <p>
     <input type="button" value="click for Message" onclick="ShowMessage();" />
   </p>
 </body>
</html>
```



If Demo Page - Windows Internet Explorer

E:\Chapter11\ifdemo.html

Your grade: 58

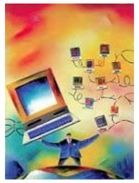
Click for Message

Windows Internet Explorer

You failed! Time to hit the books.

OK

Accessing Text Fields



recall that values entered via text boxes/areas are always returned as strings

```
if (document.getElementById('age').value >= 18) {
    alert("You are old enough to vote.");
}
else {
    alert("Sorry. You are too young to vote.");
}
```

will say that a 2-year old can vote, but a 102-year old can't!

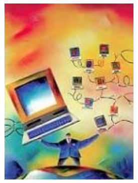
WHY?

if you wish to treat a value obtained from a text box or text area as a number, you must use the `parseFloat` function to convert it

```
age = parseFloat(document.getElementById('age').value);
if (age >= 18) {
    alert("You are old enough to vote.");
}
else {
    alert("Sorry. You are too young to vote.");
}
```

will behave as expected

Nested If Statements



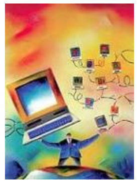
programming tasks often require code that responds to more than one condition

- this can be accomplished by nesting one if statement inside of another

example: determining wind-chill

- wind-chill is only defined for temperatures less than or equal to 50 degrees
- the initial if test is to determine if it is a valid temperature to calculate wind-chill
- the nested if statement only executes if the outer test is true

```
if (temperature <= 50) {
  if (windSpeed <= 3) {
    windChill = temperature;
  }
  else {
    windChill = 35.74 + 0.6215*temperature +
                (0.4275*temperature - 35.75)*Math.pow(windSpeed, 0.16);
  }
}
else {
  alert("Wind-chill is defined only if temperature <= 50.");
  windChill = NaN;
}
```

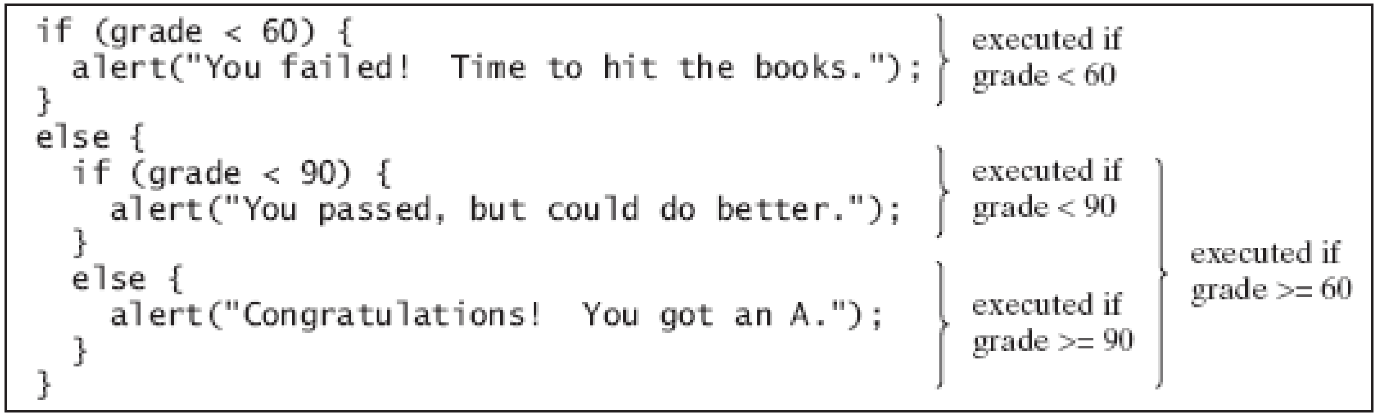


Cascading If-else Statements

nested if-else structures are known as *cascading if-else statements* because control cascades down the branches

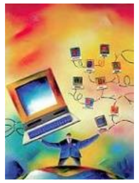
- the topmost level is evaluated first
- if the test succeeds, then the corresponding statements are executed and control moves to the next statement following the cascading if
- if the test fails, then control cascades down to the next if test
- in general, control cascades down the statement from one test to another until one succeeds or the end of the statement is reached

example: nested if-else structure



```
if (grade < 60) {
  alert("You failed!  Time to hit the books.");
}
else {
  if (grade < 90) {
    alert("You passed, but could do better.");
  }
  else {
    alert("Congratulations!  You got an A.");
  }
}
```

A Cleaner Notation



when it is necessary to handle a large number of alternatives, nested if-else statements can become cumbersome and unwieldy

- multiple levels of indentation and curly braces cause the code to look cluttered make it harder to read/understand

example: nested if statements vs. a more readable else-if

```
if (grade < 60) {
   letterGrade = "F";
}
else {
   if (grade < 70) {
      letterGrade = "D";
   }
   else {
      if (grade < 80) {
         letterGrade = "C";
      }
      else {
         if (grade < 90) {
            letterGrade = "B";
         }
         else {
            letterGrade = "A";
         }
      }
   }
}
```

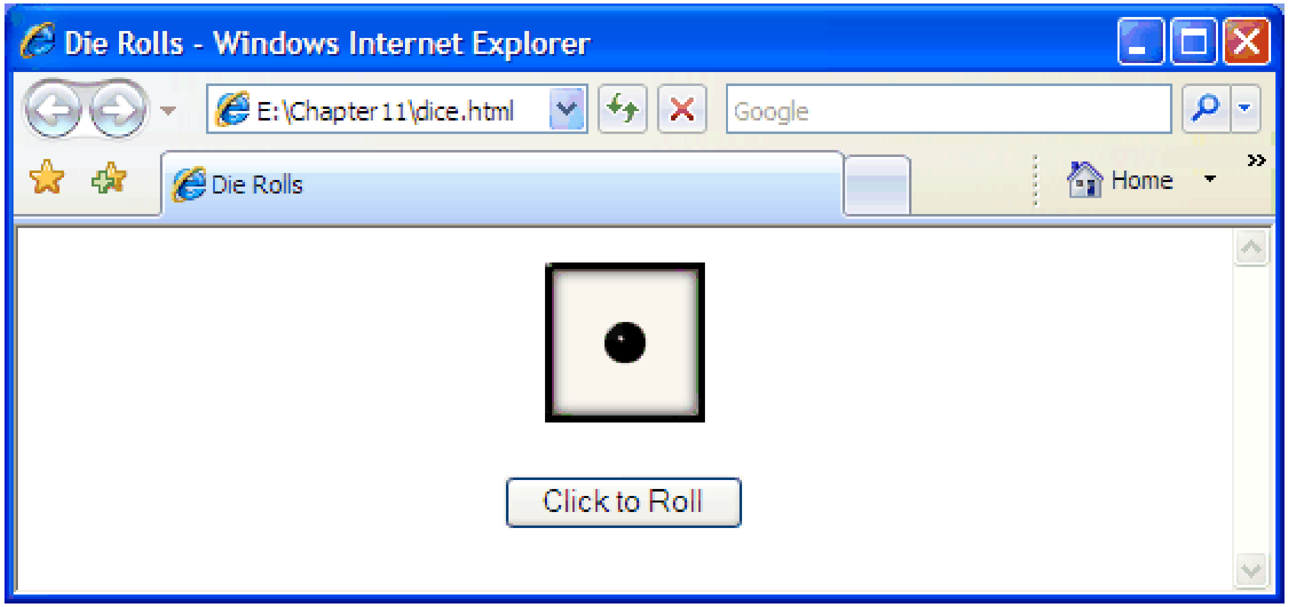
```
if (grade < 60) {
   letterGrade = "F";
}
else if (grade < 70) {
   letterGrade = "D";
}
else if (grade < 80) {
   letterGrade = "C";
}
else if (grade < 90) {
   letterGrade = "B";
}
else {
   letterGrade = "A";
}
```

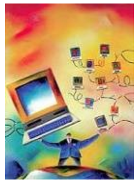
Die Roll Example

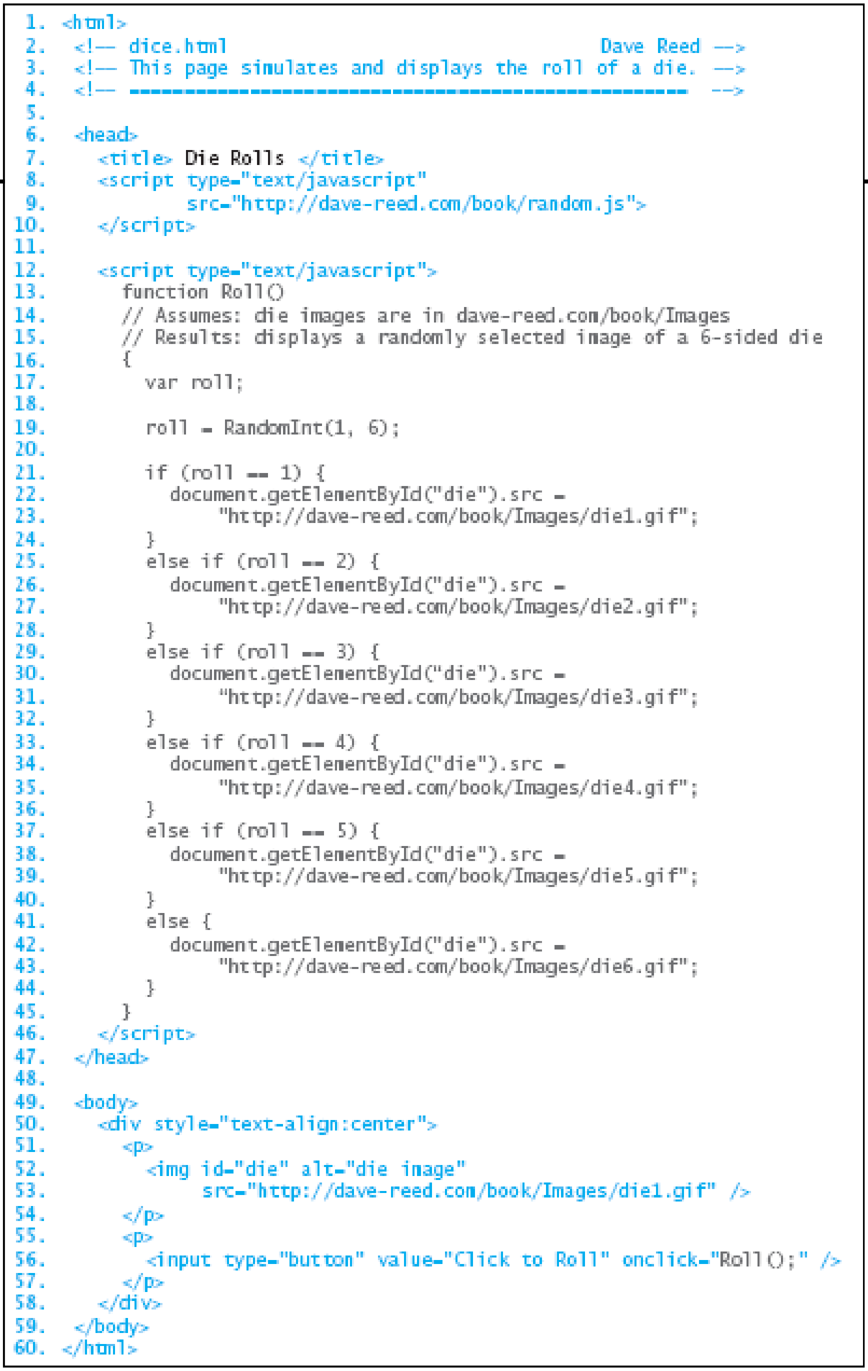
consider a Web page that simulates the roll of a single die

- will use an image to display the die
- will use a button to initiate the die roll

- when the user clicks the button, a random die roll is selected and the corresponding image is displayed







```
<html>
  <!-- dice.html                                         Dave Reed -->
  <!-- This page simulates and displays the roll of a die.        -->
  <!-- ====================================================== -->

  <head>
    <title> Die Rolls </title>
    <script type="text/javascript"
            src="http://dave-reed.com/book/random.js">
    </script>

    <script type="text/javascript">
      function Roll()
      // Assumes: die images are in dave-reed.com/book/Images
      // Results: displays a randomly selected image of a 6-sided die
      {
        var roll;

        roll = RandomInt(1, 6);

        if (roll == 1) {
          document.getElementById("die").src =
              "http://dave-reed.com/book/Images/die1.gif";
        }
        else if (roll == 2) {
          document.getElementById("die").src =
              "http://dave-reed.com/book/Images/die2.gif";
        }
        else if (roll == 3) {
          document.getElementById("die").src =
              "http://dave-reed.com/book/Images/die3.gif";
        }
        else if (roll == 4) {
          document.getElementById("die").src =
              "http://dave-reed.com/book/Images/die4.gif";
        }
        else if (roll == 5) {
          document.getElementById("die").src =
              "http://dave-reed.com/book/Images/die5.gif";
        }
        else {
          document.getElementById("die").src =
              "http://dave-reed.com/book/Images/die6.gif";
        }
      }
    </script>
  </head>

  <body>
    <div style="text-align:center">
      <p>
        <img id="die" alt="die image"
             src="http://dave-reed.com/book/Images/die1.gif" />
      </p>
      <p>
        <input type="button" value="Click to Roll" onclick="Roll();" />
      </p>
    </div>
  </body>
</html>
```

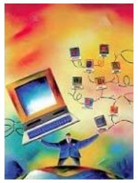
Die Roll Page

the `RandomInt` function from `random.js` is used to select the random roll

depending on the roll value, the correct image is displayed

since more than two possibilities, a cascading if-else is needed

Generalizing Code



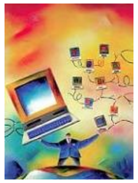
note that each case in the cascading if-else follows the same pattern

```
if (roll == 1) {
  document.getElementById('die').src = "http://dave-reed.com/book/Images/die1.gif";
}
else if (roll == 2) {
  document.getElementById('die').src = "http://dave-reed.com/book/Images/die2.gif";
}
else if (roll == 3) {
  document.getElementById('die').src = "http://dave-reed.com/book/Images/die3.gif";
}
else if (roll == 4) {
  document.getElementById('die').src = "http://dave-reed.com/book/Images/die4.gif";
}
else if (roll == 5) {
  document.getElementById('die').src = "http://dave-reed.com/book/Images/die5.gif";
}
else {
  document.getElementById('die').src = "http://dave-reed.com/book/Images/die6.gif";
}
```

this entire cascading if-else structure could be replaced by the following:

```
document.getElementById('die').src =
                         "http://dave-reed.com/book/Images/die" + roll + ".gif";
```

Counters



in software applications, if statements are often used to count occurrences of conditional or user-initiated events

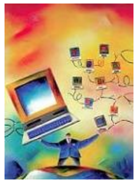
- e.g., count the number of times dice rolls come up doubles
- e.g., count the number of times the user guesses a number correctly

any variable that is used to record occurrences of an event is known as a *counter*

- initially, the counter is set to zero
- each time the specified action occurs, the counter is incremented
- after a given time period, the value stored in the counter will tell you the number of times the desired event took place

```
document.getElementById("numRolls").value =
    parseFloat(document.getElementById("numRolls").value) + 1;
```

Logical Connectives



sometimes, simple comparisons between two values may not be adequate to express the conditions under which code should execute

JavaScript provides operators for expressing multipart tests

- *logical AND* (&&): represents the conjunction of two things
  - (TEST1 && TEST2) is true if both TEST1 and TEST2 are true

```
if (roll1 == 4 && roll2 == 4) {
    // code to be executed when double fours are rolled
}
```

- *logical OR* (||): represents the disjunction of two things
  - (TEST1 || TEST2) is true if either TEST1 or TEST2 are true

```
if (roll1 == 4 || roll2 == 4) {
    // code to be executed when at least one four is rolled
}
```

- *logical NOT* (!): represents negation
  - (!TEST1) is true only if TEST1 is false

```
if (!(roll1 == 4 || roll2 == 4)) {
    // code to be executed when neither roll is a four
}
```