Cascading If

A cascading if is a composite of if or if-else statements where the true path of the outer statement is a nested if or if-else statement. The nesting can continue to several levels.

Example

A farmer can apply pesticide to a field if the temperature is at least 60 degrees, the relative humidity is between 15 and 35 percent (inclusive) and the wind speed is at most 10 miles per hour. This Java code determines whether or not conditions are right for applying pesticide. Line 6 is executed only if the Boolean expressions on lines 2, 3, 4 and 5 are all true.

```java
boolean okToSpray = false;
if ( temperature > 60 )
    if ( relHumidity >= 15 )
        if ( relHumidity <= 35 )
            if ( windSpeed <= 10 )
                okToSpray = true;
```

Example

In the Gregorian calendar, an ordinary year has 365 days and a leap year has 366, with the extra day occurring in February. A leap year occurs every 4 years and is divisible by 4; e.g. 2008, 2012, 2016 are leap years. Century markers, however, are not generally leap years but every 4th century marker is; e.g. 1900 wasn’t; 2000 was; 2100, 2200 and 2300 won’t be, but 2400 will be.

This Java code determines whether or not a year is a leap year.

```java
if ( year % 4 == 0 )  // divisible by 4
    if ( year % 100 == 0 ) // divisible by 100
        if ( year % 400 == 0 ) // divisible by 400
            leapYear = true;
    else // by 100 but not by 400
        leapYear = false;
else // by 4 but not by 100
    leapYear = true;
else // not by 4
    leapYear = false;
```
**Dangling else**

A *dangling else* occurs when a cascaded *if* has two *if* parts and only one *else*:

\[
\text{if ( truth value 1 ) if ( truth value 2 ) path 1 else path 2}
\]

This construct is potentially ambiguous, having two possible interpretations:

1. **else** matched with second *if*
2. **else** matched with first *if*

Java always associates a dangling else with the closest *if*, using the interpretation on the left. This is true regardless of any line endings and indentation.

**Example**

This Java code fragment correctly determines the number of days in February.

```java
1  if ( month == 2 )
2       if ( isLeapYear( year ) )
3           days = 29;
4       else
5           days = 28;
```
Example
This code fragment counts upper-case letters and non-letters. It uses the { and } delimiters so that the compiler correctly interprets the statement’s meaning.

```java
if ( Character.isLetter( c ) )
{
    if ( Character.isUpperCase( c ) )
        upper++;
}
else
    nonLetter++;
```

Example
Without the { and } delimiters, the compiler associates the else with the second if in spite of the indentation. This code incorrectly counts lower-case letters as non-letters and doesn’t count non-letters at all.

```java
if ( Character.isLetter( c ) )
    if ( Character.isUpperCase( c ) )
        upper++;
else
    nonLetter++;
```

Exercises

1. What is the output of this code segment if the user enters 5? If the user enters 10? If the user enters 15? If the user enters 30? If the user enters 31?

```java
double x = input.nextDouble( );
if ( x <= 20 )
    if ( x <= 10 )
        x += 11;
if ( x <= 30 )
x += 11;
System.out.println( x );
```
For each code fragment below, give the output if the user enters 45? If the user enters 75? If the user enters 105?

Ignoring whether they are indented correctly, which of them works correctly?

2. ```java
   a = input.nextInt();
   if (a <= 100)
       if (a >= 50)
           System.out.println("a is 50-100");
       else
           System.out.println("a is over 100");
```  

3. ```java
   a = input.nextInt();
   if (a <= 100) if (a >= 50)
       System.out.println("a is 50-100");
   else
       System.out.println("a is over 100");
```  

4. ```java
   a = input.nextInt();
   if (a <= 100)
   {
       if (a >= 50)
           System.out.println("a is 50-100");
   }
   else
       System.out.println("a is over 100");
```  

5. ```java
   a = input.nextInt();
   if (a >= 50)
       if (a <= 100)
           System.out.println("a is 50-100");
   else
       System.out.println("a is over 100");
```  

For each of the following use a cascading `if` to complete the code fragment.

6. A ski resort uses a snow gun when there is not enough natural snow. Optimal snow making occurs when the temperature is from 30°F down to 20°F with a relative humidity of less than 30, or a temperature less than 20°F.