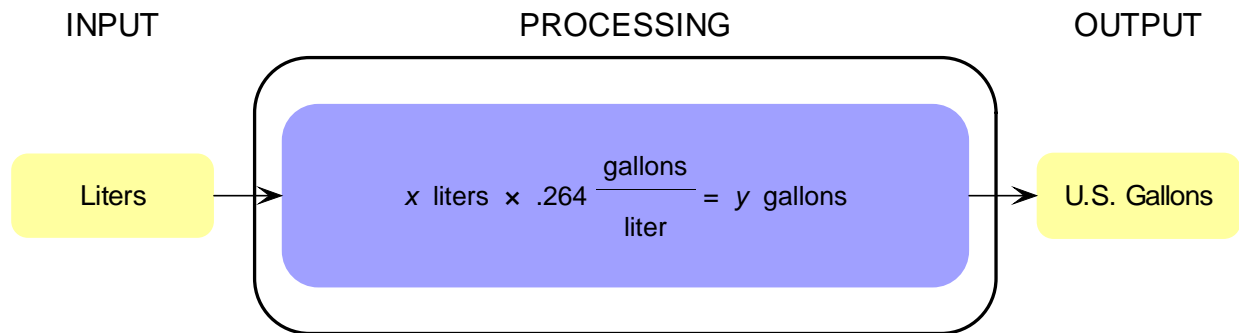# IPO PROGRAMMING EXAMPLES

Convert Liters to U.S. Gallons

Write a Java application to convert liters to U.S. gallons. A quick Google search shows 1L = 0.264 gallons. Here's an IPO diagram of the program:

INPUT   PROCESSING   OUTPUT

Liters

$$x \text{ liters} \times .264 \, \frac{\text{gallons}}{\text{liter}} = y \text{ gallons}$$
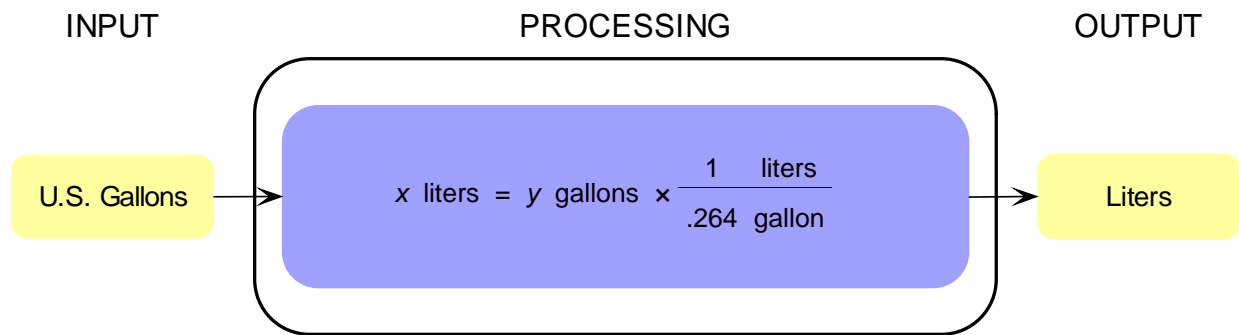
U.S. Gallons

The coded Java program is shown below.

```
 1  import java.util.Scanner;
 2
 3  public class LitersToGallons
 4  {
 5     public static void main( String [] args )
 6     {
 7        // declare data
 8        double liters;  // amount in liters
 9        double gallons; // amount in U.S. gallons
10        // input data
11        Scanner in = new Scanner( System.in );
12        System.out.print( "How many liters? " );
13        liters = in.nextDouble( );
14        // 1L = 0.264 U.S. gal.
15        gallons = 0.264 * liters;
16        // output results
17        System.out.print( liters + " L = " );
18        System.out.println( gallons + " U.S. gal." );
19     }
20  }
```

Convert U.S. Gallons to Liters

This is the inverse conversion of the previous example. Taking the conversion formula from that example and dividing both sides of the equation by the conversion factor gives this formula:

$$x \text{ liters } = y \text{ gallons } \times \frac{1 \text{ liters}}{.264 \text{ gallon}}$$

INPUT   PROCESSING   OUTPUT

U.S. Gallons → $x \text{ liters } = y \text{ gallons } \times \dfrac{1 \text{ liters}}{.264 \text{ gallon}}$ → Liters

```
 1  import java.util.Scanner;
 2
 3  public class GallonsToLiters
 4  {
 5     public static void main( String [] args )
 6     {
 7        // declare data
 8        double liters;  // amount in liters
 9        double gallons; // amount in U.S. gallons
10        // input data
11        Scanner in = new Scanner( System.in );
12        System.out.print( "How many U.S. gallons? " );
13        gallons = in.nextDouble( );
14        // 1L = 0.264 U.S. gal.
15        liters = gallons / 0.264;
16        // output results
17        System.out.print( liters + " L = " );
18        System.out.println( gallons + " U.S. gal." );
19     }
20  }
```

Height versus Time

Pretend you're in a hot-air balloon. Write a Java application that calculates how far up you are in feet based on the number of seconds it takes for a dropped ball to reach the ground.

A Google search of *calculate height by timing falling object* discovers this formula:
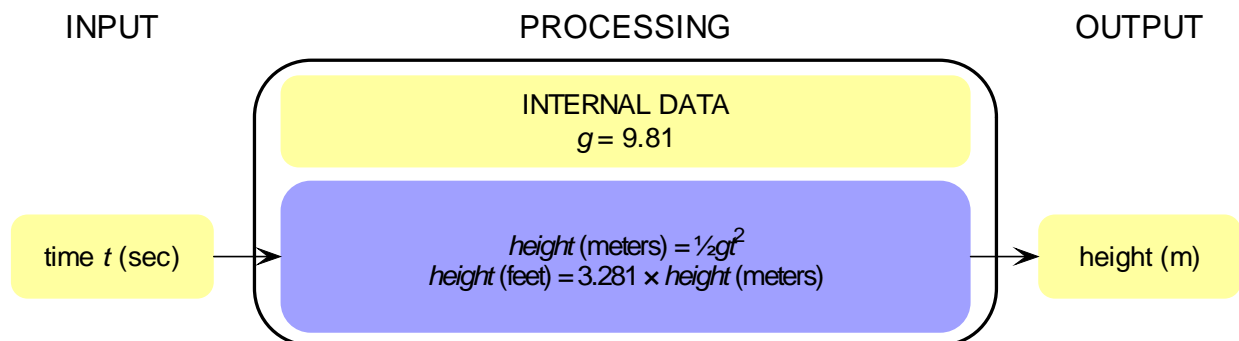
$$height \text{ (meters)} = \frac{1}{2}gt^2$$

t is the time (in seconds) it takes the ball to reach the ground. *g* is the force of gravity (9.81 meters per sec^2).

The program is to calculate the height in feet, so the height in meters given by the above formula must be converted using the formula:

$$height \text{ (feet)} = 3.281 \times height \text{ (meters)}$$

Here's the program's input, processing and output:

INPUT PROCESSING OUTPUT

INTERNAL DATA
$g = 9.81$

time *t* (sec)

$height \text{ (meters)} = \frac{1}{2}gt^2$
$height \text{ (feet)} = 3.281 \times height \text{ (meters)}$

height (m)

The coded Java program is shown on the next page. It uses the ***=** operator, which is covered in the subsequent topic *Assignment Operators*.

```
 1  import java.util.Scanner;
 2
 3  public class Height
 4  {
 5     public static void main( String [] args )
 6     {
 7        // declare data
 8        double t;  // number of seconds for fall
 9        double h;  // height
10        // input data
11        Scanner in = new Scanner( System.in );
12        System.out.print( "Enter time for ball to drop: " );
13        t = in.nextDouble( );
14        // calculate height
15        h = (9.81 * t * t ) / 2.0; // height in meters
16        h *= 3.281; // in feet, 1 m = 3.281 ft.
17        // print result
18        System.out.print( "Height = " + h + " ft." );
19     }
20  }
```

Worker's Gross Pay

Write a Java application that reads a worker's hourly wage and the number of hours he or she worked and prints his or her pay. The worker's pay is the number of hours worked times the hourly wage.

INPUT   PROCESSING   OUTPUT

hourly wage

hours worked

gross pay = hourly wage × hours worked

gross pay
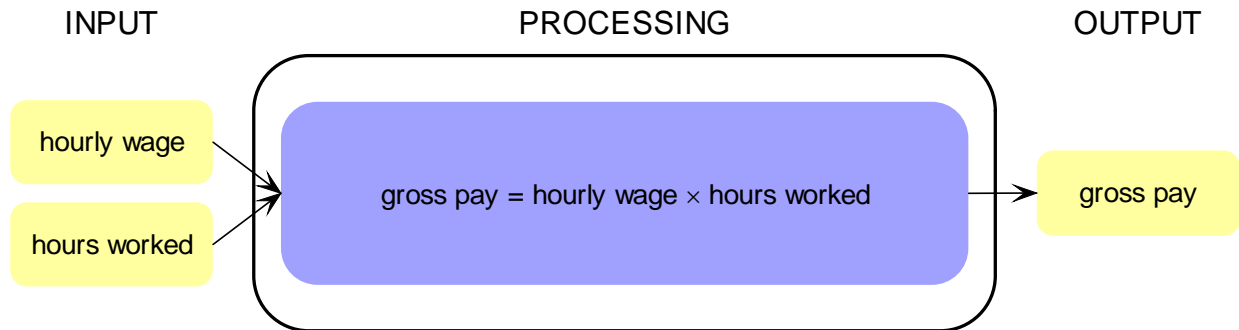
The coded Java program is shown below. Notice that you need only create one **Scanner** object from which to read all the data.

```java
 1   import java.util.Scanner;
 2
 3   public class Pay
 4   {
 5      public static void main( String [] args )
 6      {
 7         // declare data
 8         double wage;  // worker's hourly wage
 9         double hours; // worker's hours worked
10         double pay;   // calculated pay
11         // build a Scanner object to obtain input
12         Scanner in = new Scanner( System.in );
13         // prompt for and read worker's data
14         System.out.println( "Wage and hours?" );
15         wage = in.nextDouble( );
16         hours = in.nextDouble( );
17         // calculate pay
18         pay = hours * wage;
19         // print result
20         System.out.print( "Pay = $" + pay );
21      }
22   }
```