CIS 1068: Solution to Practice Problems 12

Some more practice with objects and classes, especially Random, Math, Point, and String.

1. Fields
   a. What are 3 fields we have seen so far? (Hint: 1 in the Math class, 2 in the Point class)
      
      * the PI field in the Math class (a double variable)  
      * the x and y fields in the Point class (both are int variables)  

   b. What are the values of the fields in p1 and p2 after the following code?
   Point p1 = new Point(2, 3);
   Point p2 = p1;
   p2.setLocation(3, 4);

      * p1.x = 3, p1.y = 4  
      * p2.x = 3, p2.y = 4  
      (Since p2 is a copy of the reference from p1, they point to the same data. When
      p2.setLocation(3,4) is executed, it updates the data for p2. Since p1 points to the same
      data, this same instruction also updates the data for p1.)

   c. What are the values of the fields of p after the following code?
   Point p = null;

      Trick question: p has no fields, because it is a null reference. If an object is null, then
      the variable is a row in memory that has NO reference to data. Since the fields are
      stored in the data, this means the object has NO reference to fields. Any attempt to refer
      to p.x or p.y would cause a NullPointerException.

2. Programming with fields and Methods
   a. Name at least 1 method from each of these classes: Random, Math, Point, and String.
      For each method, indicate the data type of the value it returns, and the data type of the
      arguments it takes (if any).

      Some examples:
      Random includes the following instance methods:
      nextInt(int) returns an int  
      nextGaussian() returns a double  
      nextDouble() returns a double  
      equals(Random) returns a boolean

      Math includes the following static methods:
      abs(double) returns a double  
      abs(int) returns an int
cos(double) returns a double
exp(double) returns a double
log(double) returns a double
max(int, int) returns an int
min(double, double) returns a double
pow(double, double) returns a double

Point class includes the following instance methods:
setLocation(int, int) returns nothing (void)
translate(int, int) returns nothing (void)
distance(Point) returns a double
equals(Point) returns a boolean

String class includes the following instance methods:
length() returns an int
charAt(int) returns a char
indexOf(String) returns an int
substring(int, int) returns a String
equals(String) returns a boolean

b. Write a statement to initialize an object of type Random, Math, Point, and String.

Random rand = new Random();
Math class cannot be instantiated, meaning that you cannot create objects of type Math. Instead, all of the commands are static, so you can execute them with the name of the class (eg. Math.exp(2)) rather than the name of an object.
Point p = new Point();
or Point p = new Point(2, 3);
String s = "hello";
or String s = new String(“hello”);

c. Write a statement using a method from the class Random, Math, Point, and String.

Random rand = new Random();
int dieRoll = rand.nextInt(6) + 1;

double hyp = Math.cos(Math.PI / 4);

Point p = new Point(2, 3);
p.translate(-2, -3);

String s = “hello hello”;
int firstLo = s.indexOf(“lo”);

d. How are the commands using Math methods and fields different from the other 3 classes?
The Math methods are static, so they are executed with the name of the class before the “." (dereference operator). The other classes’ methods are instance methods, so in order to execute them, you must first create an instance of the class (an object variable), and use the instance name before the “.” (the dereference operator).

e. Read a String from the keyboard. Write a loop to count how many letter T’s appear in the String. (Use the charAt() and length() methods. If you want, you can use the indexOf() method as well, but it’s not necessary.)

Scanner kb = new Scanner(System.in);
String s = kb.next();
int numT = 0;
int position = 0;
while(position < s.length()) {
    if(s.charAt(position) == 'T') {
        numT++;
    }
    position++;
}

f. What is the value of the following:

- “hello”.charAt(4)
  ‘o’ (indexes start at 0) (also, remember ‘’ around values of type char)

- “hello”.substring(2, 4)
  “ll”
  (indexes start at 0, and substring goes up to BUT DOES NOT INCLUDE the second index)
  (also, remember “” around values of type String)

- “hello”.indexOf(“ll”)
  2

- (new Point(1, 3)).setLocation(1, 5)
  (1, 5)

- (new Point(1, 3)).translate(1, 5)
  (2, 8)

- (new Point(1, 3)).distance(new Point(0, 0))
  3.16277.....
  (a double that is the square root of 10)

- (new Random()).nextInt(10)
a random int between 0 and 9

- (new Math()).sin(Math.PI)
  error: you can’t construct a Math object! It’s an error to say new Math(), since that tries to create a Math object. Instead, if you want to execute a method in the Math class, use the name of the class before the “.” like this:
  Math.sin(Math.PI)

- Math.sqrt(4)
  2.0 (sqrt returns a double)
- Math.pow(2, 3)
  8.0 (pow returns a double that is the first argument raised to the power of the second argument, or in this case 2^3).