22C:16 Homework 11

Due via ICON on Monday, May 9nd, 4:59 pm

Submit the solutions to all 3 problems, but we will grade some 2 problems of our choice from your submission.

1. Implement a class called `fraction` that we can use to represent fractions such as 2/3, -11/98, 73/17, etc. For example, I would like create an instance `x` of the `fraction` class as follows:

   ```
   x = fraction(10, 21)
   ```

   This would create an instance `x` of the `fraction` class representing the fraction 10/21. I would like you to implement the following methods for the `fraction` class:

   (a) The `add` method that could be called as:

   ```
   x.add(y)
   ```

   Here `x` and `y` are instances of the `fraction` class and after the call to `add` the fraction `x` takes on the value of `x + y`.

   (b) The `subtract` method that could be called as:

   ```
   x.subtract(y)
   ```

   and it would behave similarly to the `add` method.

   (c) The `multiply` method that could be called as:

   ```
   x.multiply(y)
   ```

   and it would behave similarly to the `add` method.

   (d) The `divide` method that could be called as:

   ```
   x.divide(y)
   ```

   and it would behave similarly to the `add` method.

   (e) The `numerator` method that returns the numerator of the `fraction` instance.

   (f) The `denominator` method that returns the denominator of the `fraction` instance.

   I want you to take care to ensure that fractions are maintained in their reduced form (e.g., 1/2 rather than 50/100) by the `fraction` class. For example, even if the `fraction` instance `y` is constructed as follows:

   ```
   y = fraction(50, 100)
   ```

   internally `y` should be represented as 1/2. Similarly, after each arithmetic operation, you should ensure that the instance that was operated upon is still in its reduced form.

   One way to ensure that `fraction` instances remain in their reduced form is to compute the greatest common divisor (gcd) of the numerator and the denominator and to divide both the numerator and the denominator by this gcd. For this purpose, I want you to implement a function called `gcd` that takes two non-negative integers and returns their greatest common divisor. *Euclid's algorithm* for computing the gcd of two numbers is one of the oldest known algorithms and it turns out to have a natural recursive implementation. One source for an easy read for Eudlid's algorithm is `http://www.jimloy.com/number/euclids.htm`

   Suggestion: Each instance of the `fraction` class should have two integer attributes to keep track of the numerator and denominator of the fraction.

   What to submit: You will have to submit the `fraction` class, consisting of the constructor, methods for the four arithmetic operations mentioned above, the `numerator` and `denominator` methods, and the `gcd` function.

2. Implement a class called `quadrilateral` for representing quadrilaterals in 2-dimensional space. I would like to create an instance of the `quadrilateral` class as follows:

```
x = quadrilateral(p1, p2, p3, p4)
```

Here `p1`, `p2`, `p3`, and `p4` are 2-dimensional points that are instances of the `point` class. After the above assignment, the constructed quadrilateral consists of line segments $\overline{\texttt{p1p2}}$, $\overline{\texttt{p2p3}}$, $\overline{\texttt{p3p4}}$, and $\overline{\texttt{p4p1}}$. You should implement a constructor for the `quadrilateral` class that raises a `ValueError` if

(a) two or more of the provided points are identical, or

(b) three or more of the points are collinear, or

(c) two or more of the line segments $\overline{\texttt{p1p2}}$, $\overline{\texttt{p2p3}}$, $\overline{\texttt{p3p4}}$, and $\overline{\texttt{p4p1}}$ intersect at an interior point.

Suggestion: Each instance of the `quadrilateral` class should have four `point` attributes to keep track of the four corners of the quadrilateral.

Note: For the `quadrilateral` class I am not asking you to implement any method except the class constructor.

3. As you well know, the world wide web is a "network" with billions of webpages, each webpage having links to other webpages. Python makes it very easy to write programs that "crawl" the world wide web. For example, here is a code snippet, that reads and outputs the 22C:16 class website. This should work fine as long as you are running it on a machine that is connected to the internet.

```
import urllib2
UF = urllib2.urlopen("http://www.cs.uiowa.edu/~sriram/16/spring11/")
for line in UF:
    print line
```

If you look at the source for the 22C:16 webpage, you will see that it is (poorly) written in a language called *html*. Links to other pages or files from this webpage have the form

```
<a href="url">url text</a>
```

Write a program that processes the 22C:16 webpage and (i) counts the number of links to other webpages (or files) there are from this webpage and (ii) determines the number of such links that are "broken." Your program should produce output reporting on these two items. The fact that your program has enountered a broken link should not cause it to crash. So you should use the `try` and `except` method for dealing with run-time errors.
