Exercise 7. *Deadline: 4 May 2009.*

COURSE OF C++ PROGRAMMING LANGUAGE

POLYNOMIAL

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Exercise

A *polynomial* is a mathematical expression involving a sum of powers in one or more variables multiplied by coefficients. A polynomial in one variable (a univariate polynomial) with constant coefficients is given by:

$$P(x) = a_n x^n + a_{n-1} x^{n-1} + \ldots + a_2 x^2 + a_1 x + a_0 = \sum_{i=0}^{n} a_i x^i$$

The individual summands with the coefficients included are called monomials. The highest power in a univariate polynomial is called its order, or sometimes its degree (if n is the degree of a polynomial $P(x)$ then $a_n \neq 0$ for $n > 0$).

Define a class `Polynomial`, which will represent a univariate polynomial. You should define the addition, subtraction and multiplication in this class.

```
class Polynomial
{
    friend ostream & operator<< (ostream &out, const Polynomial &); // output
private:
    int n; // degree
    double *c; // an array [0...n] with the coefficients
public:
    Polynomial (); // P(x) = 0
    Polynomial (int deg); // P(x) = x^n : a[n]=1, a[n-1]=...=a[0]=0
    Polynomial (double a); // P(x) = a : a[0]=a
    Polynomial (int deg, double a[]); // P(x) = a[0] + a[1]*x + a[2]*x^2 + ... + a[n]*x^n
    Polynomial (const Polynomial &poly); // copy constructor
    Polynomial & operator= (const Polynomial &poly); // copy assignment
    ~Polynomial (); // destructor
public:
    Polynomial & operator+= (const Polynomial &poly); // addition
    Polynomial & operator-= (const Polynomial &poly); // subtraction
    Polynomial & operator*= (const Polynomial &poly); // multiplication
    Polynomial & operator*= (double c); // multiply by a constant
public:
    double operator[] (int i); // read the coefficient a[i]
    void set (int i, double a); // set the coefficient a[i]=a
    double operator() (double x); // evaluation of a polynomial P(x)
};
```

Define a pair of methods for reading (`operator[]` as subscripting) and writing (member function `set`) coefficients in a polynomial. Evaluation of a polynomial consists of assigning a number to each variable and carrying out the indicated multiplications and additions. Define evaluation (the call operator `()`) more efficiently using the Horner scheme:

$$((\ldots(a_n x + a_{n-1})x + \ldots + a_2)x + a_1)x + a_0$$

Finally write a program, which reads two polynomials P and Q from the standard input, calculates P/Q and $P \bmod Q$, and write the results to the standard output.

Hint

Some information about the polynomials can be found on the webpage:

`http://en.wikipedia.org/wiki/Polynomial`