

Problem Set 3: Classes, Constructors, and Destructors

Problem 1

Sieve of Eratosthenes:

We start with the integer number 2, which is the first prime. To obtain the rest of the primes, we continue by filtering the multiples of 2 from the rest of the integers. This leaves a list beginning with 3, which is the next prime. Now we filter the multiples of 3 from the rest of that list. This leaves a list beginning with 5, which is the next prime, and so on.

In other words, we construct the primes by a sieving process, described as follows: To sieve the integer numbers from 2 to N, build a list of prime filters, whose first element is a filter for the integer 2 and the rest of which is obtained by filtering all multiples of 2 out of the rest to N and generating a new prime filter for each new prime number found:



Implement a C++ console application that defines a prime filter as outlined above. In order to implement the application define the following two classes:

```

class Filter
{
private:
    Sieve& fSieve;
    int fPrime;
    Filter* fNext;

    static int fNumberOfFilters;

public:
    Filter( Sieve& aSieve, int aPrime );
    ~Filter();

    void check( int aNumber );
    int getNumber();

    static int getNumberOfPrimes();
};
  
```

```

class Sieve
{
  private:
    Filter* fPrimes;
    int fMaxNumber;
    int fLastNumber;

    public:
    Sieve( int aNumber );
    ~Sieve();

    bool nextNumber();
};

```

The main function is defined as follows:

```

int main()
{
  cout << "The sieve of Eratosthenes: 1000" << endl;

  Sieve ISieve( 1000 );

  // filter all prime numbers
  while ( ISieve.nextNumber() );

  cout << "Done, " << Filter::getNumberOfPrimes() << " primes found!" << endl;
}

```

Running the program must produce the following output:

```
> ./Eratosthenes
```

```

The sieve of Eratosthenes: 1000
New prime number found: 2
New prime number found: 3
New prime number found: 5
New prime number found: 7
New prime number found: 11
...
New prime number found: 991
New prime number found: 997
Done, 168 primes found!
deleting filter for 997 ...
deleting filter for 991 ...
...
deleting filter for 3 ...
deleting filter for 2 ...

```

Submission deadline: Thursday, March 8, 2007, 11:00 a.m.

Submission procedure: on paper in class.