# CS 2SC3 and SE 2S03 Fall 2008

## Programming Exercise 2

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Revised: 13 October 2008

**Files due: 16 and 23 October 2008**

The purpose of this programming exercise is to learn how to (1) use loops in OCaml and C and (2) create, compile, and execute programs consisting of more than one file.

### Background

Two positive integers are *relatively prime* if they have no common divisors except 1. For example, 10 and 21 are relatively prime but 10 and 15 are not. The *totient* of a positive integer $n$ is the number $\varphi(n)$ of positive numbers $\leq n$ that are relatively prime to $n$. For example, $\varphi(12) = 4$ since $\{1, 5, 7, 11\}$ is the set of integers $\leq 12$ that are relatively prime to 12. The function $\varphi$ is called *Euler's totient function*. It is an important function for number theory that is used, for example, in Euler's theorem on integers modulo $n$.

### Part A

Write an OCaml program that satisfies the requirements listed below. Put your implementation of the `euler` function in a file named `prog2.ml`, your test code in a file named `test2.ml`, and your log book in a file named `log.txt`. Put all three of these files into a directory named `ex-2-a`. Using subversion, import this directory into your directory in the course subversion repository. Your files must be submitted no later than **10:30 a.m. on Thursday, October 16, 2008.**

### Part B

Write a C program that satisfies the requirements listed below. Put your implementation of the `euler` function in a file named `prog2.c`, your main procedure and test code in a file named `test2.c`, and your log book in a file named `log.txt`. Put both of these files into a directory named `ex-2-b`. Using subversion, import this directory into your directory in the course subversion repository. Your files must be submitted no later than **10:30 a.m. on Thursday, October 23, 2008.**

## Program Requirements

1. The set $\mathbf{Z}$ of integers is represented by the (OCaml and C) type `int`.
2. Using a loop, the program implements a function that tests whether two integers are relatively prime.
3. Using a loop, the program implements the unary function

$$\mathsf{euler} : \mathbf{Z} \to \mathbf{Z}$$

   specified by the following table:

| condition | $\mathsf{euler}(n) =$ |
|---|---|
| $n < 0$ | $\varphi(-n)$ |
| $n = 0$ | $1$ |
| $n > 0$ | $\varphi(n)$ |

4. The program tests the implementation of euler on a representative set of inputs.
5. When the program is executed, it prints out the the results of testing euler.

**Notes**:

1. Please put your name and MAC ID at the top of each of your files.
2. Your programs must be your own work.
3. Your programs must compile and execute correctly on either mills or moore to receive full marks.
4. Files submitted late will receive no marks.