ES 112 Final Examination
Fall 2003-2004

1 Case Inversion

Write a C function that takes a pointer to a null-terminated string as an argument, and modifies that string so that every lowercase character in the string is converted to uppercase, and every uppercase character in the string is converted to lowercase. The prototype of the function should be:

```
void invertCase(char *s);
```

For instance, if the function is called with the string ``Hello, world!'', the string should be modified to become ``hELLO, WORLD!''.

2 Grade Structure

A C structure that can hold the (integer) grades of a class is defined as below:

```
struct classGrades {
    int grades[100];
    int numGrades;
    double mean;
};
```

The structure is designed to be able to hold the grades for a class of at most 100 students. The member array `grades` holds the grades. The member `numGrades` holds the actual number of grades held in the array. (For instance, if `numGrades` is 10, only the first ten elements of `grades` holds actual grades, the rest are unused.) The member `mean` is for holding the artihmetic average of the grades.

Your task is to write a C function as follows: Assume that a `struct classGrades` exists with `numGrades` set properly, and with `grades` filled with as many grades as necessary. However, the `mean` has not been calculated, and therefore contains a garbage value. The function you are supposed to write should take a pointer to such a structure, calculate the mean (as a `double`) using the information in the strucuture, and then store the mean of the grades in the member `mean` of the structure. The prototype of the function should be as below:

```
void fillMean(struct classGrades *grades);
```

3 Multiply without Multiplying

Write a C function that takes an integer as an argument, and returns six times that integer as its return value. But, there is a catch: You are not allowed to use the multiplication operator. You are not allowed to call any C library or other functions. All that you are allowed to use is *one* addition operator and *two* bit-shifting operations. The prototype of the function is as follows:

```
int sixTimes(int n);
```

4 Copy a File

Write a C program that will ask the user for an input filename, and an output filename, which are no longer than 79 characters each. Then, the program should copy the contents of the input file to the output file. The length of the file to be copied is not known. If either file can not be opened, a proper error message should be printed. If there are no problems, the output file should be identical to the input file as the program exits.