CSCE 150A Homework 05 Spring 2009

Due 2:00PM, Thursday, April 23rd, 2009

Name _____ CSE Login _____

Instructions Follow instructions *carefully*, failure to do so may result in points being deducted. For written questions: type your answers; for programming code, use a monotype font (like `Courier New`). Print your answers hardcopy and staple this cover page to the front of your assignment. Be sure to write your name on the front.

For each of the programs, place your source code into files named `homework05program01.c`, `homework05program02.c`, etc. and turn them in using the webhandin available on the course webpage. You do not need to print out your source code for the programs.

You may discuss problems with your classmates, but all work must be your own. The CSE academic dishonesty policy is in effect (see `http://www.cse.unl.edu/undergrads/academic_integrity.php`).

Question	Points	Score
1	10	
2	10	
3	10	
4	10	
5	20	
6	20	
7	20	
Total:	100	

1. [10 points] Write the following function:
   ```
   void removeBlanks(char *dest, const char *src)
   ```
   which copies `src` into `dest` but with all spaces removed. Note that, similar to the standard string functions, this function assumes that `dest` is large enough to hold the copied string.

2. [10 points] Write a recursive function that returns the value of the following recursive definition:

$$f(x,y) = \begin{cases} x - y & \text{if } x < 0 \text{ or } y < 0 \\ f(x-1,y) + f(x,y-1) & \text{otherwise} \end{cases}$$

3. 10 points Recall that a *palindrome* is a word that is spelled exactly the same when the letters are reversed. Write a *recursive* version of a function to determine if a string is a palindrome or not.

```
int isPalindrome(char *dest, int x)
```

4. 10 points Define a structure type called `element_t` to represent an isotope of elements from the periodic table. Components should include: Atomic Number, Atomic Weight, Element Name, Element Symbol, and Half-life (zero if it is stable).

5. 20 points **Program 1**: (Adapted from Programming Project 2, Chapter 9, p495) A resistor is a circuit device designed to have a specific resistance value between its ends. Resistance values are expressed in ohms (Ω) or kilo-ohms (kΩ). Resistors are frequently marked with colored bands that encode their resistance values. The first two bands are digits, and the third is a power-of-ten multiplier. The various colors can be stored in an array of strings as follows.

```
1  char COLOR_CODES[10][7] = {"black", "brown",
2    "read", "orange", "yellow", "green", "blue",
3    "violet", "gray", "white"};
```

Notice that `"red"` is `COLOR_CODES[2]` and has a digit value of 2 and a multiplier value of 10^2. in general, `COLOR_CODES[n]` has a digit value of n and a multiplier value 10^n. For example, if the first band is green (5), the second is black (0), and the third is orange (3), the resistor has a value of $50 \times 10^3\Omega$ or 50kΩ.

Write a program that prompts for the colors of Band 1, Band 2, and Band 3 and then displays the resistance in kilo-ohms.

6. 20 points **Program 2**: The rate of decay of a radioactive isotope is given in terms of its half-life H, the time lapse required for the isotope to decay to one-half of its original mass. For example, the isotope Strontium-90 (^{90}Sr) has a half-life of 28.9 years. If we start with 10kg of Strontium-90 in January 2009, then by the end of October 2037 we would expect to have only 5kg of Strontium-90 (and 5kg of Yttrium-90 and Zirconium-90, isotopes which Strontium-90 decays into).

Write a program that reads the following from the *command line*: Atomic Number, Atomic Weight, Element Name, Element Symbol, as well as: H (half-life of the element), m, an initial mass in grams, and an integer n.

Your program will then print out a table detailing the amount of the element that remains after each year for n years. This amount can be computed using the following formula:

$$r = m \times C^{(y/H)}$$

$C = e^{-0.693}$ (note: $e = 2.71828$), y is the number of years elapsed, and H is the half-life of the isotope in years.

For example, calling your program as follows:

```
~>a.out 38 90 Strontium Sr 28.9 10 3
```

would produce a table that looks *something* like:

```
 Strontium-90 (38-Sr)
Elapsed Years    Amount
-------------------------
-                10g
1                9.76g
2                9.53g
3                9.30g
```

7. [20 points] **Program 3** (Adapted from Programming Project 6, Chapter 11 p604) The results of a survey of the households n your township have been made available. Each record contains data for one household, including a four-digit integer identification number, the annual income for the household and the number of members of the household. You may assume that no more than 25 households were surveyed. Write a program that prompts the user to enter survey data which is stored into an array of user-defined structures of type `household_t`. Then perform the following analyses:

   1. Print a three column table displaying the data (Identification Number, Annual Income, Number of Household Members)
   2. Calculate the average household income, and list the identification number and income of each household whose income exceeds the average.
   3. Determine the percentage of households having incomes below the poverty level. The poverty level income may be computed using the formula:

      $$P = \$7,500.00 + \$950.00 \times (m - 2)$$

      where m is the number of members of each household. This formula shows that the poverty level depends on the number of family members m and the poverty level increases as m gets larger.

   Helpful Hint: to avoid reentering data while testing your program, you can place the book's table into a text file and use input redirection (see Section 2.7 of your text).