

Purpose

The purpose of this assignment is to give you practice with writing functions and Nested FOR loops.

Problem

You are required to write a program to print 2 tables of temperature values converting Celsius to Fahrenheit.

The first table should display the following columns: Temperature in Celsius, Temperature in Fahrenheit, several columns of Temperature in Fahrenheit which include Wind Chill factor (one column for each wind speed starting 5mph up to 40mph in increments of 5mph).

The second table should display the following columns: Temperature in Celsius, Temperature in Fahrenheit, several columns of Temperature in Fahrenheit which include Heat Index factor (one column for each relative humidity percentage starting at 40% up to 100% in increments of 10).

The headings for each column must also be printed i.e. Celsius, Fahrenheit, Wind speed (or Heat index) value. For any temperature value that's not valid for either Wind Chill calculation or Heat Index calculation print a "X" in that column.

Scenario

Wind chill is the perceived decrease in air temperature felt by the body on exposed skin due to the flow of air.

Wind chill numbers are always lower than the air temperature for values where the formula is valid. When the apparent temperature is higher than the air temperature, the heat index is used instead.

In 2001 there were corrections made to the wind chill calculations and the formula for computing this in U.S customary units are:

$$T_{wc} = 35.74 + 0.6215T_a - 35.75V^{+0.16} + 0.4275T_aV^{+0.16}$$

where T_{wc} is the wind chill index, based on the Fahrenheit scale, T_a is the air temperature, measured in °F, and V is the wind speed, in mph.

Wind chill temperatures are valid for temperatures upto 50 deg Fahrenheit only and when the wind speed is 5 miles or more.

The heat index is an index that combines air temperature and relative humidity in an attempt to determine the human-perceived equivalent temperature—how hot it feels. Like the wind chill index, the heat index contains assumptions about the human body mass and height, clothing, amount of physical activity, thickness of blood, sunlight and ultraviolet radiation exposure, and the wind speed.

In the late 1970s there was a formula developed to calculate the heat index and this formula below approximates the heat index in degrees Fahrenheit, to within ± 1.3 °F

$$HI = c_1 + c_2T + c_3R + c_4TR + c_5T^2 + c_6R^2 + c_7T^2R + c_8TR^2 + c_9T^2R^2$$

where

HI = heat index (in degrees Fahrenheit)

T = ambient **dry-bulb temperature** (in degrees Fahrenheit)

R = relative humidity (percentage value between 0 and 100)

$c_1 = -42.379$, $c_2 = 2.04901523$, $c_3 = 10.14333127$, $c_4 = -0.22475541$, $c_5 = -6.83783 \times 10^{-3}$, $c_6 = -5.481717 \times 10^{-2}$,
 $c_7 = 1.22874 \times 10^{-3}$, $c_8 = 8.5282 \times 10^{-4}$, $c_9 = -1.99 \times 10^{-6}$.

Heat index formula is valid only when the temperature is 80 deg Fahrenheit or above and when the relative humidity is 40% or more.

[35 points]Function Compute_Wind_Chill ()

Input arguments: Integers for range of Celsius temperature values (1 Input argument for starting Celsius value, 1 Input argument for ending Celsius value)

Output arguments: None

Function Return value: Integer containing number of Fahrenheit values below 20 degrees.

- Converts temperature from Celsius to Fahrenheit for the range of temperatures provided in steps of 1 degree increments.
- Table shows the original Celsius and the computed Fahrenheit temperature as the first 2 columns, additional columns for Wind Speeds from 5mph to 40 mph in increments of 5. The Fahrenheit temperature for each wind speed with Wind Chill factor must be printed under the particular Wind Speed column.
- Returns count of temperature values less than 20.

[35 points]Function Compute_Heat_Index ()

Input arguments: Integers for range of Celsius temperature values (1 Input argument for starting Celsius value, 1 Input argument for ending Celsius value)

Output arguments: None

Function Return value: Integer containing number of Fahrenheit values above 100 degrees.

- Converts temperature from Celsius to Fahrenheit for the range of temperatures provided in steps of 1 degree increments.
- Table shows the original Celsius and the computed Fahrenheit temperature as the first 2 columns, additional columns for Relative Humidity from 40% to 100% in increments of 10. The Fahrenheit temperature for each relative humidity with Heat Index factor must be printed under the particular Relative Humidity column.
- Returns count of temperature values greater than 100.

For both computations irrelevant columns should contain a “X” (i.e. if the initial Fahrenheit temperatures are greater than 50 for Wind Chill and less than 80 for Heat Index)

You need to use a Nested FOR statement to calculate and print values for each table.

[20 points]Main Function should display some information to the user as to how the program works. It should take input from the user for specifying the range of values, if the range is outside of -20 to 50 an error message should be displayed and the user must be prompted to enter new values. You do not need a loop to keep getting new inputs from the user if a correct range of values are entered. If a valid range is input by the user, it calls the functions `Compute_Wind_Chill()` and `Compute_Heat_Index()` to compute and print the two tables of values. After returning from each function, the `main()` function prints information about the total number of “extreme” temperature values (i.e. totals of wind chill less than 20 and totals of heat index above 100).

[10 points]Comments and Code Organization

Input

Input should be taken from the user only in the `main()` function. The input will come from standard input, that is, from a user at the keyboard.

Output

Output will be sent to standard output (the screen). The initial message about the program to the user and any error messages about the input should be output in the `main()` function.

Testing

On all your assignments, including this one, it is crucial that you test your program thoroughly.

Do not add additional features that are not being asked for, since your program may not run against test inputs that I have created.

Details

- You must follow all the coding style rules as specified in our “coding guidelines”. In particular:
 - You must put your name enclosed in a comment box at the top, and keep any other comments that are already there.
 - Keep lines to the point of making your code easily readable. It is a good idea to make your comment box lines 66-80 characters long and use this as a guide.
 - You must use good names for any variables you create (a full word that describes what it is there for).
- Details that you do not follow are penalized after other scored items are added up, so even if you got a 100 for the functionality of your program, you can still get a lower score because you did not follow all the other requirements for the assignment.

Submission

Submit this assignment with the code 5P followed by the name of your source file – for example if `ctof.c` is the name of your file:

```
submit 5P ctof.c
```